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MEMOIRS

OF THE

GEOLOGICAL SURVEY OF INDIA.

Palæontologia Indica,

BEING

FIGURES AND DESCRIPTIONS OF THE ORGANIC REMAINS PROCURED DURING THE PROGRESS OF THE GEOLOGICAL SURVEY OF INDIA.

PUBLISHED BY ORDER OF HIS EXCELLENCY THE GOVERNOR GENERAL OF INDIA IN COUNCIL,
UNDER THE DIRECTION OF

THOMAS OLDHAM, LL. D.

Fellow of the Royal and Geological Societies of London; Member of the Royal Irish Academy; Hon. Mem. of Leop-Carolino Academy of Natural Sciences: of the Isis, Dresden, &c. &c.

SUPERINTENDENT OF THE GEOLOGICAL SURVEY OF INDIA.

CRETACEOUS FAUNA OF SOUTHERN INDIA.

Vol. II.

The Gastropoda, by Ferd. Stoliczka, Ph. D., F. G. S.,

Palæontologist, Geological Survey of India.

CALCUTTA:

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SUPERINTENDENT OF THE GEOLOGICAL SURVEY OF INDIA.

V. 1—4. The Gastropoda of the Cretaceous Rocks of Southern India,

by Ferd. Stoliczka, Ph. D. Geological Survey of India.

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RICHARD I. JOHNSON

NOTICE.

The present issue of the *Palæontologia Indica*, being a continuation of the descriptions of the fossils from the South Indian cretaceous rocks, contains the first portion of the GASTROPODA, embracing the PULMONATA, and the PROSOBRANCHIA SIPHONOSTOMATA.

This part contains the four fasciculi due for the year 1867-68, now issued in one: the four succeeding fasciculi will complete the GASTROPODA.

T. OLDHAM.

CALCUTTA,
March 31*st*, 1867.

INTRODUCTORY REMARKS.

Whenever a large number of different natural objects is to be described, it is always most desirable, that this be done according to some certain systematic arrangement. In palæontology, where the fossil forms are sometimes so very different from the living ones, such an arrangement is almost indispensable, as it is the most essential guide to understanding the relationship between the present and the former organisms. It is well known that, although species, genera, and other higher divisions of the animal kingdom have become extinct during the course of time, they still form a part of one universal system of organic life on our planet. The principal task, therefore, of the palæontologist is clearly to examine these fossil remains with reference to their relations to existing forms, and thus, in co-operation with the zoologist, gradually to furnish the materials for a true natural system in the animal kingdom.

In bringing before our readers the descriptions of the Gastropodous remains of the South-Indian cretaceous rocks, we have tolerably extensive and varied materials to deal with. It may, therefore, not be out of place to offer, first, a few remarks on the classification of the Mollusca in general and subsequently on that, which is to be adopted in our present more special and limited case.

Several conchologists regard the Gastropoda as the most highly organized of the Mollusca; and taking into consideration that they include forms with usually a well-developed head, organs of generation and of respiration, etc.,* this classification will appear by no means unfounded. The Cephalopodous form is certainly of a type lower in its organization, but it had attained, so to say, the maximum, or at least a much higher grade, of development in a certain direction, or upon a certain plan, in which gradual progression seems to have taken place in the organization of the Mollusca. The functions of several organs in the Cephalopoda—those of the central nervous, as well as others of the muscular and the generative systems—in general appear, however, to give to this class a higher place in the general arrangement of the Mollusca than to the Gastropoda, and on this account it was that the former obtained, especially since the times of Lamarck and Cuvier, the first rank among the Mollusca. A careful comparison of the different systems, which had at various times been proposed, will be found in

* Many of them being air-breathers solely.

the third volume of Bronn's 'Klassen und Ordnungen des Thier-reiches,' pp. 8 and 9. It will be sufficient here to refer to this valuable publication, and to restrict our own remarks to one or two arrangements proposed subsequently to that publication.

Dr. Mörch in a paper* 'On the systematic value of the organs . . . in the classification of the Mollusca' arrives at the conclusion, that the locomotive, respiratory and other organs, which had been previously—by Lamarck, Cuvier, Blainville,† and others—used as the leading principles in classification, do not really possess the value attributed to them; but that this is to be found in the 'heart' and the 'generative organs.' The author consequently divides the Mollusca (from which, strangely enough, he excludes the Bryozoa, Brachiopoda and others) into two series, Monoto-cardia and Dioto-cardia. Each of these is further separated into two classes, namely, Androgyna and Exophallia on the one, Pseudophallia and Acephala on the other hand. The air breathing Univalves are considered of all the Mollusca the highest, and the monomyarian Bivalves the lowest in organization. As an instance, we may refer to the Cephalopoda, which are represented as being a little degree higher in organization than the Pelecypoda, forming with the *Dentaliidæ*, the Polyplacophora, Cyclobranchiata, part of the Scutibranchiata, *Helicina* and others, the class Pseudophallia. In fact such heterogeneous forms are brought together in this newly proposed classification, that no practical success seems likely to follow from its adoption, although several good hints regarding the development of certain forms from others appear to be contained in it.

Very instructive information is embodied in another paper on the classification of Mollusca based on the principle of cephalization by E. S. Morse.‡ The plan, upon which the Mollusca are organized, is stated to consist principally in the form of the fleshy sac containing the viscera and stomach. Mr. A. Hyatt consequently proposes to replace the name 'Mollusca or Molluscozoa,' by the more appropriate one, Saccata, equivalent to, and corresponding with, the names Vertebrata, Articulata, and others. The morphological researches of Mr. Morse are quite in accordance with the generally accepted classification of the Mollusca, namely, into Bryozoa (Ciliopoda§), Brachiopoda, Tunicata (Tunicopoda‖),

* Ann. Mag. Nat. Hist., London, 1865, 3rd Ser., Vol. XVI, p. 385.

† *Vide* Principes de Zooclassie, ou class. d. animaux, Paris, 1863 (Posthumous).

‡ Amer. Jour. Sc. and Arts, 1866, 2d. Ser., Vol. XLII, No. 124, p. 19.

§ We propose this name with reference to the cilia, or tentacles, surrounding the aperture.

‖ Proposed, with reference to the entire mantle serving, by its muscular action, or through its different appendages, as a locomotive organ.

Pelecypoda, Gastropoda and Cephalopoda, arranged in order from the lowest to the highest type. These six principal divisions or classes of the Mollusca are generally accepted by the majority of conchologists, (with the exception of the Ciliopoda, the Molluscous characters of which are only very slowly acknowledged).

Confining ourselves at present to the Gastropoda, and in a case like the present, when reporting only upon an imperfect local fauna, it would perhaps be a great advantage, if we strictly followed some system, which had been adopted and exemplified in any of the leading Manuals of the Mollusca. It is not, however, easy to select from among the numerous systems which have been at various times proposed one equally well suited to the zoologist and the palæontologist.

In Woodward's 'Rudimentary treatise of shells,' the general classification of the Gastropoda is much clearer and more easily understood than in many other Conchological works; and the ways, in which the families are described according to their respective relations, appear to be adequate to the state of our yet very imperfect anatomical knowledge of the animals. This treatise is undoubtedly indispensable for the student of Conchology; still it would at present seem more advisable to carry out in the generic nomenclature a more detailed division, than has been adopted by Woodward. A similar objection,—if it can be called one,—may be raised against the classification in Philippi's 'Handbuch der Conchyliologie,' 1853; and still more decidedly against the older systems of Lamarck and others.

The adoption of smaller and more easily defineable generic groups has, during the last few years, been found not only to have increased very considerably our specific knowledge of the animals, but it has also most remarkably facilitated the study of the Mollusca in general. Many points in morphology and in geographical distribution, which would scarcely have had a chance of being so soon cleared up, so long as the universal generic denominations such as *Cerithium*, *Fusus*, *Tritonium* and others remained in use, became at once far more intelligible in consequence of the new system of sub-division. Perhaps it would be more correct to say, that the more detailed studies of the organization, the habits and the geographical distribution, rendered this closer division more a matter of necessity than of mere convenience, as it appeared to be at first. Swainson, in his able 'Conchology' (1840), was one of the first, who classified in the more recent sense the Gastropoda into a number of characteristic families and sub-families, and he also nearly doubled the then existing number of genera. The same course was more systematically pursued by Dr. J. E. Gray, especially in his last 'Catalogue of the Mollusca in the British Museum' (1857), and by Henry and Arthur Adams, in their 'Genera

of recent Mollusca' (1853-58). It is greatly to be regretted, that in neither of these two publications have the fossil shells been included, because without these it is impossible to complete a system. This want ought to have been supplied by Chenu's 'Manuel de Conchyliologie,' (Pt. 1, 1859), which is little more than a translation of H. and A. Adams' 'Genera', but with the addition of a large proportion of the fossil forms, so far as these were known to the author. In the numerous and well-executed, though not always very correct, drawings this 'Manuel' has its own strong recommendation. The system of the 'Genera' is, however, strictly adhered to, and the genera of fossil shells are simply inserted in the scheme of the recent ones, although upon a little more consideration the former would have suggested several highly desirable alterations. This reduces the originality and partly the value of the book, specially as it has often been left without many important observations on families and genera, which are given in the English original.

One of the most valuable contributions to the general knowledge of the Mollusca will be found in the third volume of Bronn's 'Klassen und Ordnungen des Thier-reiches' (1858-63), forming a copious compendium of nearly all existing information regarding that division or sub-kingdom of animals. The anatomy of the animals, the formation of the shells, the systematic, geographical, and geological distribution are treated of more extensively, than can be found in any other similar Manual. It is only to be regretted, that it has not been the good fortune of the originator of that grand publication to complete it. The systematic arrangement of the Mollusca is in many respects an original and improved one, while in others it presents an apt and careful selection from what was already known.

Bronn's chief divisions of the Malacozoa are Acephalomalacia and Cephalomalacia. The latter contain the Cephalopoda, Gastropoda, and Scaphopoda. The first of these, which is considered the highest in organization, has been already treated of in our previous publication of the South-Indian cretaceous fauna.*

The Scaphopoda, Prosopocephala, or Cirrobranchia, include the single family *Dentaliidæ*, while all the rest of the headed Mollusca are treated by Bronn in the class Gastropoda, which is divided into the following orders: Pteropoda, Cuvier; Opisthobranchia, M. Edwards; Heteropoda, Lamarck; Prosobranchia M. Edwards; Pulmonata, Cuvier. The Prosobranchia, which include the majority of known shells, are further divided into *Chitonidæ*, Cyclobranchia,

* Palæontologia Indica, Ser. I and III.

Aspidobranchia, Ctenobranchia, and Neurobranchia ('Pulmonifera operculata,' H. and A.Adams). It is not our object here to enter upon any discussion of the value of these various divisions; but looking first at the Prosopocephala, or Scaphopoda, it is evident from Bronn's treatise (loc. cit. pp. 523-564), that many of the characters of the *Dentaliidæ*, as the presence of tentacles (though numerous) on the head, the close connection of the foot with at least a portion of the digestive organs, the unilateral opening of the genital organs, the teeth on the radula and others, are in many respects the same as those in the largest number of other Gastropoda. It is true that, according to the latest researches of Lacaze-Duthiers and Sars, the *Dentaliidæ* appear to be in many respects of a much lower organization than had been previously believed. It is said that they have no heart, nor any special respiratory organ, and that the entire surface of the body, not attached to the shell, acts as the latter, although this last statement does not appear to be satisfactorily proved as yet. We have among other Gastropoda also many instances of a very low organization, for we meet with species, which have no heart, and consequently no regular circulation (in *Rhodope* of the Opisthobranchia); others which have no mouth or special organs of respiration (many Gymnosomata of the Heteropoda), and still, looking to the totality of the organization, we cannot but retain these and other forms in the respective orders, or families, to the species of which they are in other respects closely related.

Comparing, on the other hand, the five sub-orders of the Prosobranchia, the assemblage appears to us rather heterogeneous; and we would suggest to exclude from them the first and the last, namely, the Polyplacophora, *(Chitonidæ)*, and the Neurobranchia, classing these as separate orders, equivalent to the Prosobranchia. Both are entitled to this rank; the former by the want of tentacles and the articulated shell, and the latter by the respiratory organ, and consequently different mode of life. We would then have, as formerly acknowledged, only two divisions in the Cephalomalacia, namely, Cephalopoda and Gastropoda. The latter could then be further divided into eight orders: 1, Pulmonata; 2, Neurobranchia; 3, Prosobranchia; 4, Heteropoda; 5, Polyplacophora; 6, Opisthobranchia; 7, Pteropoda; 8, Prosopocephala.

In the course of our descriptions, we shall retain this classification, although only four of the orders, the Pulmonata, Prosobranchia, Opisthobranchia and Prosopocephala, (or Scaphopoda), will occupy our special attention, because of the other orders no representatives have as yet been discovered in the South-Indian cretaceous rocks.

As to sub-orders, families and genera we shall to a great extent follow Gray's 'Catalogue,' or H. and A. Adams' exposition, in their 'Genera,' although we shall not refrain from making such alterations as appear called for by the examination of the fossil shells.*

Until within the last few years, it has been the usual custom in fossil Conchology to follow a few standard works, which had been carefully executed in accordance with the systems of Lamarck and Cuvier. There can be no question that this course very greatly facilitated the understanding of the general character of the shell, especially where the palæontologist had to deal with only a small number of species. Still a great drawback in fossil Conchology has been produced, in that the comparison of the extinct forms with living ones has been so much neglected, or at least retarded. A large number of generic names has thus been introduced into the literature of Conchology, very often for no other reason than that all the species belonging to them were extinct, or at least were believed to be so. Fossil shells also were occasionally treated solely with reference to their identity, similarity, or difference as compared with those already described from the same or similar deposits, and as being characteristic for a certain geological formation. It is only natural that the importance of the last point should not be overlooked by the palæontologist; but it was not until Ed. Forbes, Darwin, Dana, Lyell, and others showed the vast importance of applying results, derived from the study of physical conditions in connection with the recent fauna, to the examination of the fossil faunæ, that the great physico-geological results, which we now see rapidly progressing, received that attention which was due to them. It was proved that species of a certain form and organization only live or prosper under certain favorable circumstances, at a certain depth, temperature, and other conditions of the water, or climate, on certain ground, &c., and that from an examination and correct recognition of the characters of the fossil shells, it is possible to form correct conclusions as to the past physical conditions, under which the respective strata have been deposited. An enormous field of new and most interesting inquiry into the former conditions of life on our globe was thus opened for the geologist and palæontologist. The 'formations' of the geologist ceased to be looked upon merely as a series of beds with some characteristic fossils, but appeared in the light of a series of beds deposited under various physical conditions and in a great ocean swarming with organic beings, which were adapted to those various conditions.

* The want of references vastly increases the difficulty in the critical use of the book, and is, as well as the very strange and unusual names occasionally adopted, justly complained of by many conchologists.

Changes made on one side proved the necessity for others, and it was seen that by no better and more accurate means could the correct comparison of the former with the present physical conditions be tested than by the study of the organic life, and specially of that of the Mollusca. It was then necessary to go into a closer comparison of the fossil* forms with the living ones, and to make use of the considerable systematic progress which had been attained in recent Conchology principally through anatomical researches.

The great disadvantage in studying fossil forms is, that direct observation as to the connections existing between the animal and its shell are to a great extent still in their infancy. It is most important to know which particular secretion on the aperture corresponds to a certain organ, and in what connection this latter stands to the total organism; whether its changes are essential and necessarily dependent upon others in the organisation of the animal, or whether they may be produced by, and can therefore be attributed to, local and accidental causes only. We can hardly expect, that our fossil genera will have an unquestionably firm basis, until these morphological and anatomical studies have been very considerably advanced. It is, however, by no means intended to say that our present knowledge of the anatomy of the animals is so totally deficient, that we cannot form any certain conclusions from the structure of the shell to that of the animal. We do not need to enumerate the many most valuable results, which have been already obtained from those studies in fossil Conchology.

But the more we enter into a detailed examination of local faunæ, the more urgent appears the necessity for reducing to some extent the old established 'grand' generic groups, and for adopting instead the smaller and more easily defineable genera, which have been established by the more rapid progress of recent Conchology. I hardly need to repeat, that our studies, both systematical, as well as physical and geographical, are most remarkably simplified by the adoption of this course. That we shall have to struggle, for some time to come, with the number, limit and definition of those genera is an undoubted fact, but this does not in the least invalidate the principle, which ought to be adopted. It is most probable, for instance, that a large proportion of the genera and sub-genera, introduced by H. and A. Adams in their 'Genera' will prove to be quite unnecessary, others will be differently determined, and many more are constantly proposed. But when all the recent shells have been thus carefully examined, several of our, as at present believed, fossil genera will be shown to have still living representatives, and others, which have really disappeared altogether, will be entered into the system according to

* I mean to refer here principally to the meso-and palæo-zoic fossils.

their respective relations. The recent fauna is only a remnant of that which existed during the previous periods of life on our globe, and its uniform plan of organization is sufficient proof that, strictly speaking, the present fauna marks only a certain stage in the entire progressive development of organic life.* Unless, however, I am very much mistaken in the meaning of the term of a *natural system*, (which I believe ought to be *the exposition of this gradual development of organic life*), I am entirely at a loss to perceive, how conchologists can expect to arrive at a natural system from and through the examination of the recent species alone!

Were it certain that there are in reality no extinct, new, or differently typical, forms of Mollusca known, no such objection could be very reasonably raised; but as the reverse is to the extent of our present knowledge an undoubted fact, the conchologist must look upon a purely zoological system only as a partial systematical arrangement, or an incomplete attempt at a natural system.

Perhaps the system now adopted, which has become so highly favoured among a number of conchologists, might well be called hyper-anatomical. It sounds almost like a dream to hear of the grand results, which are expected to be derived from the examination of the dentition of a few species, when Mr. Mörch says, that "a monographic research, chiefly based on the teeth of the genera *Nassa*, *Fusus* and *Buccinum*, found on the coast lines from the arctic regions to the equator, would probably be sufficient to prove, whether species in *each fauna* are created originally, or are only varieties dependent on different climates, and would at the same time prove the relations between the species of succeeding geological periods." Where, whether, and how all these inquiries of the past and the present are inscribed on the teeth of the Mollusca will probably not be easy to find out. This seems to me a similarly exaggerated idea, as if some palæontologist would attempt to obliterate a carefully obtained zoological result through the examination of a few imperfect shells, for such they are in the largest number of cases in our fossil Conchology. It is only by the co-operation of both the zoologist and palæontologist (although the latter will always gladly give the lion's share to the former), that a true natural system of Conchology can be obtained.

For some time I entertained the project of collecting all the different types of Mollusca, and specially of the GASTROPODA, from the oldest to the more recent formations, and thus being in possession of a series of types for comparison with the living shells. A task like this is, however, not easily executed, for the

* When certain highly organized forms are placed under the influence of conditions of life so different, that their organs lose something of their inherited development, instead of becoming more highly specialized, this case of so-called retrograde metamorphosis can scarcely be looked upon as anything more, than an exceptional case, inasmuch as it does not interrupt the general tendency to progression.

geological position and the probable conditions, under which the respective fossils lived and were buried, ought to be always correctly ascertained. As soon as our palæontological materials are more complete, such a series of shells will prove highly instructive. We have to compare then the series of each successive formation with the preceding, note the changes of form with reference to that of organisation, inquire into the causes which may have produced these, and deduce from this the direction, plan and degree of progressive development. Such a thorough examination of the entire fossil and living order of the Mollusca in one locality, or rather so to say in one basin, or geographical area, would give us a better and firmer basis for a natural system than anything else, and when such inquiries have been in reality, so far as possible, extended over the entire globe, we shall have then in hand at least a portion of the materials, which we require for that system. We must, of course, necessarily be contented with a certain number of typical forms, for to obtain all the fossil species which have existed is almost beyond our expectation.

This is the principal reason why, in describing a large local fauna, we thought it right to take advantage of the opportunity for the proposition of a few systematical changes.

In conclusion I ought probably to say a few words in justification of the great length to which my memoir on the GASTROPODA has been extended. It was indeed only after mature and repeated considerations, that I entered upon the difficult and laborious task of making references to the recent fauna at all. When, however, I found the necessity for adopting a large number of generic names instead of one, as used by several other palæontologists, the further necessity arose of grouping these into families and so on. In giving occasionally a review of the cretaceous genera and species of a family already known, it was almost impossible not to mention at the same time other recent genera of the same family. In this way the bulk of the information increased, and I afterwards thought it useful to give, besides, a brief review of the zoological character of each family or sub-family if necessary, so as to aid, even slightly, the student of Conchology in India, where the desirable means of reference are not so easily procurable, as they are in almost every large town in Europe.

Several other additions and explanations of little known genera of shells will perhaps be welcome even to some of my colleagues in the study of Conchology.

F. STOLICZKA.

CALCUTTA,
MARCH 1867.

GASTROPODA

OF THE

CRETACEOUS ROCKS OF SOUTHERN INDIA.

Sub-kingdom, MOLLUSCA.
Class, GASTROPODA, *Cuvier.*

CHARACTERS.—*Mollusca, with a more or less distinct head, being generally provided with tentacles,* a muscular foot developed for digging, swimming, fastening on submarine objects, creeping, or rudimentary,† with or without other locomotive appendages of different shape; mantle open usually in front and below, more rarely on both ends,‡ or even wanting; shell, if present, either univalve or multivalve,§ with or without an operculum, which is not exactly equivalent to the second valve of the Pelecypoda or Elatobranchia; genital organs placed usually unsymmetrically, seldom symmetrically,‖ or in pairs,¶ but always opening on one side only.*

We have previously noticed, that it appears convenient to divide the entire class of Gastropoda into eight orders; namely, *Scaphopoda, Pteropoda, Opisthobranchia, Chitonidæ (Polyplacophora,* Blv.*), Heteropoda, Prosobranchia, Neurobranchia* and *Pulmonata.* The cretaceous rocks of Southern India have not as yet yielded remains of all these orders, and there is, therefore, no inducement for us to notice those, which are absent, any farther in detail. For sufficient information as to all the orders and other sub-divisions, we would specially refer the reader to the description in Bronn's "Klassen und Ordnungen des Thierreiches," Vol. III (continued by Dr. Keferstein).

The remains of Gastropoda, which we are about to describe more fully here, belong to the four divisions, the *Scaphopoda, Opisthobranchia, Prosobranchia* and *Pulmonata,* and we shall confine our remarks to what may be necessary to the understanding of these four divisions, so far as regards the special purposes of our present description and the geological importance of the groups.

* To these Bronn's name *Pselaphocephala* refers, but as they are wanting in almost a greater number of species, than is the foot, the name is not more characteristic. The tentacles are wanting in a few genera of the Heteropoda, Opisthobranchia, Pteropoda, and in all Chitonidæ.

† The foot is wanting in one or two Pteropoda and three or four other genera of the Gastropoda even as a rudiment. ‡ In the Dentalidæ. § Chitonidæ. ‖ Dentalidæ. ¶ Chitonidæ.

As is generally the case, the Prosobranchia are, in the rocks referred to, by much the most numerous. It would be, no doubt, a more natural course to open our descriptions with the lowest group—*Scaphopoda*—but following the arrangement already adopted in the previous descriptions of a portion of the Mollusca from the same rocks (*see* Palæontologia Indica, Cretaceous Cephalopoda of Southern India) we shall begin with the highest order, the *Pulmonata*. Generic characteristics will be given in greater detail where necessary, and especially, when a genus is introduced for the first time into the literature of cretaceous *Mollusca*. Cases will sometimes occur, when a more general,—usually an older denomination of a *genus*,—is retained as the principal name, while a second is given in a parenthesis. The latter usually refers to a name used for the genus in a more restricted, and generally a newer or more recent, sense. We would simply repeat here, that we prefer leaving room for further correction by exposing the insufficiency of the materials at our command, rather than by using terms of fixed meaning to attempt to give an apparent, but possibly fallacious, completeness to the descriptions. Even in some well preserved fossil shells, there still remains for the most part so much that is doubtful, and so much that must be mere supposition, that we must be careful to avoid any hasty descriptions of imperfect specimens, which would frequently admit of more explanations than one.

The geological terms to be used in reference to the cretaceous rocks of Southern India, will be the same* as those already used in the descriptions of the Cephalopoda. Four groups of beds are distinguished; the *Arrialoor*, *Trichinopoly* and *Ootatoor* groups in the Trichinopoly district, and the *Valudayur* group from the neighbourhood of Pondicherry. The last (the Valudayur) may be taken as nearly equivalent to the lowest division (the Ootatoor) of the Trichinopoly series, although the equivalence seems to be only partial. Many of the fossils, which were examined from these beds, appear to indicate, that some Arrialoor beds had been classed with them, and it may even be possible that these younger beds constitute the greater portion of this group. Very strict boundaries between each of the groups were not defined by means of the geological or stratigraphical examination of the rocks. We must hope that the palæontological enquiry, when extended over the entire fauna, may throw some light upon the value of these divisions, and that the distribution of the various groups of fossils will help to explain much as regards the co-existence, or succession in time, of the various deposits.

We may here anticipate the remark, that while the Ootatoor group has yielded the largest number and greatest variety of Cephalopoda, the Arrialoor and Trichinopoly groups contain to the same degree a much richer fauna of Gastropoda. At the close of the detailed descriptions, the results, as regards this class, will be given in the same way, as already attempted with the Cephalopoda. If not specially mentioned it will be understood, that the specimens described or figured are deposited in the collections of the Geological Survey of India. With regard to nomenclature

* These will be found more fully treated of in Mr. H. F. Blanford's report in the 4th Volume of the Memoirs of the Geological Survey of India.

we shall use, in the course of our descriptions, the generally accepted expressions; to avoid, however, any misapprehension a few remarks will probably not be out of place.

In all our figures, we have adopted the position with the apex of the shell *above* and the aperture *below and in front of* the observer. Strictly speaking the choice of this or of the reversed position, as used chiefly by French Conchologists, depends merely on the habit to which a naturalist has been accustomed. Neither of these positions, as is well known, is throughout strictly natural or corresponding with that of the living shell, and as regards illustration, the one has no peculiar advantage over the other. In a few swimming species, the reversed position may be thought more natural, while the regular position, with the apex above, is in the greater number of conical shells not only natural, but as regards certain fixed terms in common use is decidedly preferable.

As to the different forms of the shells, the expressions used need no farther explanation; they are all very familiar and easily understood. The name of 'body whorl' applying to the 'last whorl' *(anfractus ultimus)* will be omitted, as it has no real significance in the Gastropoda.

Speaking of the aperture, the expressions 'below' and 'above' will also be omitted, because they are liable to cause misunderstanding in the reversed position of the shell, and the respective expressions 'anterior' and 'posterior' will invariably be used. The same remark applies to the names of 'right' and 'left' lip or peristome, in place of which the corresponding terms of 'outer' and 'inner' or 'columellar' lip are less liable to cause confusion in cases, when any one desires to refer to a figure, for which elsewhere a reversed position has been chosen. If not particularly noticed, we shall understand by 'inner' lip, that portion of the peristome, which adheres immediately to, or covers partially, the preceding whorl, and which is also often called the columellar lip. The posterior angle of the aperture marks, generally speaking, the posterior junction of the outer and inner lip, which are here either *united* or *separated*. The anterior junction of these two requires, however, often a special explanation in the different groups, if it is not clearly marked by the anterior canal, or at least a slight notch of the aperture, as in the greater number of the Prosobranchia.

Considerable difference exists as regards the terms, which are used for the designation of the so-called 'umbilicus.' We shall, in all cases, cease to use the word 'perforated,' because there is in reality scarcely a single Gastropod shell, which can be truly called perforated, and because the original meaning of the term, as first introduced, has in the course of further enquiry been so variously applied, that the simple use of the word now leaves an observer in doubt, or, when no special explanation of the expression is given, rather leads to misapprehension. In our description, we shall use only two principal terms, which we regard as correlated to each other, namely, *umbilicus* and *columella*. The first is either *open*, or *covered* with a callosity, the latter *hollow* or *solid*; both in different degrees and varying in form requiring always special notice, not only in different species, but often even in certain specimens of the same species.

A shell, which is coiled in a regular plane, is umbilicated on one or, generally, on both sides; but in most cases, the basal (or lower) is deeper than the apical (or upper) excavation. When the volutions are coiled in such a manner, as to rest on the upper part of the succeeding whorl with their whole basis, or only with a portion of it, while the apex of the shell is raised conically, a similar conical excavation is thus formed on the side opposite to the apex, or internally of the shell. In this case we call the excavation an 'umbilicus,' the form and size of which depends upon those of the shell. The central perpendicular axis of umbilicated shells, which expresses their height, is, therefore, only imaginary. Further it depends on the angular or rounded forms of the whorls, and on the kind of involution or coiling, whether the inner volutions are partially visible within the umbilicus, or whether this latter forms a regular hollow cone, as in many *Helicidæ*, on the one hand, and in many *Trochidæ* on the other. The umbilicus may often be covered with a callose mass, which on the further growth of the shell may be absorbed, or may remain and fill up the excavation. Instances of this kind occur in the *Naticidæ*, *Neritopsidæ* and others.

When, on the contrary, the basal portion of each whorl is partially covered or embraced by the succeeding whorl in order to form a certain axis, round which the volutions are coiled up, we call this axis a *columella*. The formation of this columella depends on whether the inner lip covers the preceding whorls in its entire extent, or only partially, and whether it is very thin or thickened; according to this the columella is either solid or hollow, and in itself either very thin and loose, or strongly and consistently built by the callose mass of the inner portion of the peristome. Solid columellæ are found in *Fusus*, *Buccinum*, etc., hollow in *Cancellaria*, *Nerinea;* very thin and slight in *Turritella*, strong in *Rostellaria* and *Cerithium*, etc.

The inner lip sometimes remains partially free at the base, so as to form a hollow in the columella. In growing larger, however, the free or raised portion of the inner lip is absorbed and, while forming a solid columella, the same hollow is again restored at the new peristome of the aperture, as is, for instance, observed in some species of *Chemnitzia* and others. In this case, the expression *fissure* may probably be well appropriated. Depending on the peculiar character of the spiral coiling of a shell, it will be seen, that while in some cases there appears to exist a very sharp distinction between umbilicus and columella, in others they approach, or even amalgamate with each other. Taking it very strictly we may say, that a columella is always present, when the singular whorls are contiguous and coiled cone-like. In shells, the whorls of which are not contiguous, as is sometimes the case in *Scalaria*, *Vermetus* and others, we can speak neither of a columella, nor of an umbilicus.

Proceeding with the descriptions of the species, we shall often note a few measurements, as—

1.—The spiral angle, according to D'Orbigny's Helicometer;

2.—The sutural angle, by which we understand the angle formed by the ascending suture and a horizontal plane at right angles to the axis of the shell.

3.—The proportion of the height of the last, and, occasionally even of the penultimate whorl, to the height of the axis.

It must be understood, that these and any other measurements regarding the actual size of shells will be only noticed, when they can be of use in the reconstruction of the shell, or when they are in other respects characteristic. The scale used will be, as before with the Cephalopoda, the millimetre. There is little use in quoting measurements of already figured specimens, or even actual measurements in general, excepting as regards the usual size of a species, or its greatest variation.

In the descriptions of species we shall, as usual, give first a diagnosis in Latin, while the rest of the description will generally be more explanatory, than a mere translation of the diagnosis. Observations on similar species already known, and comparisons with these will be carefully noted, because these are in many cases of far greater importance, than any imperative characteristic of a new species. Regarding known species, we shall continue to notice largely all facts of identity and affinity, and to illustrate them amply with the specimens at our disposal. Special geological interest always attaches to the occurrence of these known species. The same system will be retained in referring to the different genera and families, and to their geological distribution in time and space, as well as to their conchological relations.

It is not necessary at present to make it an object to enumerate all known Cretaceous fossil species of the genera described, as this work has only just been completed by Prof. Pictet (Mat. p. l. Pal. Suisse, 3rd Ser. 1864.). If, however, any particular additions or considerable alterations have been made since the date of Pictet's publications, we shall not omit to attend to this subject. In 1861 (Proc. Am. Phil. Soc. Vol. VIII.) W. Gabb published a catalogue of what he then supposed to be all known Cretaceous Mollusca. The number of fossils, however, omitted from this catalogue is very considerable, and a little want of care in the critical examination greatly reduces the value, which such a publication, if properly executed, would so highly deserve.

Order. **PULMONATA,** *Cuvier.*

CHAR.—*Air-breathing Gastropoda with or without a shell; lungs situated in front of the heart or behind it, and the respiratory cavity opening with a roundish hole only; hermaphrodite, with reciprocal impregnation; without a metamorphosis, the young animal resembling the parent in shape and not provided with deciduous, cephalic fins.*

In conformity with the somewhat limited extent of dry land during the earlier formations, air-breathing animals seem not to have been very numerous, although they were not wanting even in some of the oldest periods. The first somewhat doubtful remains of air-breathing Gastropoda are found in the coal-measures and not very certain traces were noticed in fresh-water deposits of the Lias and Jura. True Pulmonata were described first from the Wealden, but the remains even here, and in the cretaceous deposits, are very scarce. By far the greatest number, which is calculated to amount to about 600 species, have been derived from the cainozoic deposits, the eocene, as well as the neogene. From our cretaceous rocks, only a few species have been procured, and these all belong to the

Sub-order. **Stylomatophora.**

the members of which are all terrestrial animals characterized by having their eyes on the ends of retractile peduncles, the tentacles being separate and placed below the peduncles; no operculum.

*Family.** *HELICIDÆ.*

Sub-family. HELICINÆ.

Except the *Boysia Reussii*, which was in 1859 described by myself from a cretaceous fresh-water deposit in the North-eastern Alps,† I am not aware that any species of true Helicinæ‡ have been noticed from deposits lower than the eocene strata, although I may be unacquainted with some publications at present bearing on this point. The four species, here described under two genera, are, therefore, of very great interest, both in the study of the *Pulmonata* in general and in that of the fauna of the South-Indian cretaceous deposits especially. The greater number of our specimens were found in the loose conglomeratic or gritty sandstones of the Arrialoor group, or the highest division of the series of deposits, together with marine shells. This mode of occurrence increases the interest of these few Helicidæ very much, and supports Mr. H. Blanford's statement, that the Arrialoor deposits have been formed, partially at least, in very shallow waters.§ Land was evidently not very far off, and it cannot surprise us, therefore, when we see land shells occurring associated with a rich fauna of truly marine species. Helicidæ inhabited the shores and islands of the cretaceous sea, and consequently their shells

* We accept the terminations of—*idæ* and—*inæ* for the denominations of families and sub-families respectively.

† Sitzungsb. Akad, Wien. Bd. XXXVIII. p. 493, pl. 1, fig. 17.

‡ *Helix Gentii*, and other species noted by Sowerby are now universally acknowledged as *Natica*, *Trochus*, etc.

§ Mem. Geol. Surv. India, Vol. IV, pt. 1, p. 163.

could, by occasional higher tides or higher reach of the waves, have been without any difficulty carried away to greater or lesser distances from the shores, and there buried with the marine inhabitants of the place. Similar cases occur in the tertiary deposits also, as has been noticed by Deshayes in the Paris basin, and by Dr. M. Hörnes in the Vienna basin. With regard, indeed, to the *Helix Turonensis*, Desh. of the latter basin, it has been proved that the species survived the marine fauna with which it occurred. The species continued to exist on unaltered, although the sea had disappeared from the shores which it inhabited, since it has been found fossil in the marine, brackish and the fresh-water deposits of one and the same place, where these deposits can be very clearly seen to have succeeded each other.

This is a point of very high interest and of great importance in attempting to trace out the changes of climate, and other correlated phenomena, towards the close of one and the commencement of another formation. When we can establish, that the terrestrial fauna did not change during two successive periods, in which considerable changes and distribution of sea level took place, we can conclude with tolerable certainty, that the climate of the place was, during both these periods, pretty nearly the same, and also, that if any changes have taken place, they must have occurred by so slow a process, that the animals could easily acclimatise themselves. Sudden changes in the terrestrial faunæ would lead us to suspect some rapid alterations in the climatal conditions and configuration of the land, and probably an equally sudden change in the neighbouring waters. But our physico-geological investigations are still too deficient to enable us to define the limits, within which terrestrial changes have affected the organic life of the adjoining seas and *vice versâ*. It is, however, certain that much knowledge may be anticipated from careful local enquiries and thorough examination of special basins. Instances of an admixture of land with marine shells occur still on the shores of almost every sea, more especially where banks with shallow water exist.

Of the four species to be here described, *Anchistoma cretaceum* was more common: the other species were very rare, but although only known from single specimens, these are mostly sufficient to enable us to characterize the species, and, therefore, are well worthy of notice. This will also, I hope, induce subsequent observers to devote greater attention to these very interesting shells. It can scarcely be doubted, that a careful search in these deposits would largely reward the observer, by adding to the number of cretaceous land,—and probably fresh-water,—shells also.

H. and A. Adams unite, under the sub-family of *Helicinæ*, a number of genera into which Lamarck's genus Helix had been divided. It is well known, that Linnæus included, under Helix, besides the common land-snails, many fresh-water and even marine shells. Subsequent naturalists, and especially Lamarck, defined and restricted the genus more carefully, and among others Pfeiffer made it an object of his special study, the results of which are well known through his able monograph of the *Helicidæ*. In his earlier publications, Pfeiffer strictly defended the unity of Lamarck's genus Helix, in his later researches he does not

appear indisposed to adopt a division of the old genus, Helix, into smaller groups under different names. And there can be no question that such sub-division is rendered quite necessary even in the present imperfect state of our knowledge of all the respective animals.

With all the apparent similarity, the variation in the form of the shell and coincidently, to some extent, in that of the animal itself, is still so manifold, that it is not easy to characterize even the sub-family *Helicinæ*, in its restricted sense, as given in the more recent Conchological treatises. But what the characteristics of the genus Helix in Lamarck's sense might be, is readily seen when we read in Woodward's Manual, or Bronn's 'Klassen und Ordnungen' a. o., that it comprises shells of discoid, globular and conical form, umbilicated, perforated or imperforated; with a transverse, oblique, lunar or round aperture; with its margins distinct, remote or united by callus ! ! etc. No one can fairly or seriously object, if Conchologists attempt to classify these and other so widely different characters under different names.

Of this sub-family, *Helicinæ*, we notice two genera Anchistoma and Macrocyclis.

I.—Anchistoma, *Klein.* 1753.

Anch. testa orbiculari, spira plana seu subconvexa; anfractibus numerosis, subtus omnibus vel duobus ultimis conspicuis, seu umbilico clauso; ultimo anfractu prope aperturam contracto, deflexo atque nonnunquam gibboso; apertura subrotundata, expansa, intus sæpissime callosa, ad margines dentibus seu plicis munita.

The genus Anchistoma comprises a number of chiefly small species of *Helicinæ*, which are distinguished by a large number of narrow whorls, the last of which is deflexed and usually provided inside with some kind of teeth or plaits. The inner lip is mostly callose, tooth-like and projecting into the space of the aperture, while the outer lip is expanded and reflected. There can be no doubt, that the species attributed to this genus, as they can be seen amply illustrated on plates 64—66 in Pfeiffer's "Schnirkel-schnecken" 1846, form a sufficiently natural group to be distinguished by a separate name. Among themselves they present, however, several characters which seem to make a still farther sub-division into small groups very desirable. We notice in general the helicoid and non-umbilicated forms with somewhat elevated spire, and the more planorboid and umbilicated forms. Among these again those which have all their previous volutions visible in the space of the umbilicus, and others in which the last or the two last whorls are so much enlarged below, as to cover this space nearly totally. Similarly to this the dentition of the aperture varies. The peristome is only somewhat thickened and expanded; or there are a number of plaits or folds present in the inside of the whorls, disappearing near the mouth partially or totally; or there are differently shaped teeth at the peristome only and not extending into the inner spaces of the whorls.

Considering these and other points of distinction H. and A. Adams quote five subgenera, which, however, do not seem to be as well defined as appears necessary. To make these separations of real classificatory value, it is absolutely necessary, that they be based upon the examination of the animals as well as the shells, so as to be certain whether the respective organs can in any way be depended upon as to their constancy. Meanwhile we prefer to describe the cretaceous species under the more extensive heading of *Anchistoma*.

The greater number of living species of Anchistoma is known from America and Europe. From India there are only a few species described for some of which Adams proposed the name *Corilla* (in place of *Atopa*, Albers). Mr. Benson includes under this name mostly South Indian and Ceylon species only, while for some others, chiefly from Burmah and North India, he proposes a second name, *Plectopylis*, based upon a difference in the pylaic plication. (*Vide* Ann. Mag. Nat. Hist. 1860, III, Ser. Vol. V, p. 243.) It appears that the species were in former periods nearly as numerous as they are at present in India. We describe three, namely, *A. cretaceum*, *Arrialoorense* and *Arcotense*, all of which are new, and the first, apparently rather a common shell resembling in form European species, while the two others have up to the present been found only in single specimens also partly resembling species from Europe, but in general form next to the Indian *Plectopylis*. Several Anchistoma are known from the tertiary deposits of Europe.

1. Anchistoma cretaceum, *Stoliczka*. Pl. I., Figs. 1—5.

A. testa conico-depressa, spira parum elevata, apice obtusa, mamillata, late profundeque umbilicata ; anfractibus senis, angustis, lente accrescentibus, convexis, sutura impressa junctis, supra transversaliter oblique striatis ; ultimo prope aperturam lateraliter constricto atque rursus expanso, vix deflexo, striis subtus evanescentibus, in œtate adulta ad umbilici marginem rotundato, juniore carinato ; apertura obliqua, rotundate semilunari, intus dentata atque obsolete plicata ; labro atque labio prope aperturam bidentato, dentibus superioribus crassioribus et bifidis, inferioribus elongatis pliciformibus utrinque ad angulum posteriorem peristomatis nonnullis plicis tenuibus munitis, peristomate exteriore vix reflexo.

Largest specimen in our collection from Comarapolliam measures 8·5 mm. in height and 20 mm. in width.

	a.	*b.*	*c.*
Height of the shells : transversal diameters (taken as 1·00),	0·43	0·51	0·54
Width of outer whorl above : transversal diameter	0·18	0·17	0·18

a, b, c, being specimens figured in Figs. 4, 5, 3, respectively.

As to form, this fine species resembles the American *Anchistoma auriculatum*, Say, which has very nearly the same number of equally narrow whorls. The spire is in our species more or less elevated, but not exceeding an angle of 130 degrees. The increase of the whorls is very gradual; the first or embryonal one or

two whorls being smooth, and proportionally larger or wider than the following. These are distinctly convex, separated by an impressed suture and obliquely and transversely striated, the striæ disappearing on the sides and on the base of the last whorl. The latter has its greatest width above the centre, becoming gradually narrower towards the umbilicus, the margin of which is in the adult and perfect shell evenly rounded, while in the young shell it is angular or even carinated, as shown in figure 2, Pl. I. The width of the umbilicus at the base amounts to about one-third of the whole basal diameter; but as not more than a portion of the preceding whorl could be exposed from the adherent rock, it is uncertain whether more volutions are visible in its space or not. In any case it is certainly very narrow lower inside. Further, the last whorl is near the mouth, laterally and somewhat below the middle, strongly contracted or compressed. (Fig. 3.b.) To this contraction correspond two strong teeth inside, which have two equally formed teeth corresponding on the opposite inner lip. The upper of these teeth is much stronger, short and bipartite, the lower is fold-like, thinner and longer. Besides these, there are on the upper portion of the inner lip two other thin fold-like plaits, and one near the suture on the outer peristome. These three folds are seen in several of our specimens, but in none extending far inside of the whorl. Close to the aperture, which is of semilunar shape, the last whorl is again, as before, regularly expanded or a little inflated and somewhat deflexed. The outer peristome itself is scarcely enlarged and reflexed, its plane having a position very oblique to the axis of the shell.

Localities. Neighbourhood of Comarapolliam, at Ninnyoor and Veraghoor; at the first locality rather common in soft light coloured sandstone.

Formation. Arrialoor group.

2. Anchistoma Arrialoorense, *Stoliczka*. Pl. I, Fig. 6.

A. testa discoidea, late umbilicata, spira vix elevata; anfractibus quinis, teretibus, supra convexis, sutura impressa junctis, obsolete transversim striatis, lente crescentibus; ultimo antice deflexo, basi rotundato, prope aperturam parum constricto; apertura perobliqua, ovate rotundata: peristomate exteriore expanso, angulatim reflexo; interiore anfractu penultimo adherente, moderate calloso.

Height of the shell : transversal diameter (taken as 1·00)	0·39
Width of one whorl above : transversal diameter	0·23

The shell of this species is nearly discoid, the spire being hardly elevated, but the umbilicus is, so far as it could be traced, very large, occupying nearly half of the total width of the basis. The surface of the shell, which appears to have been very thin and pellucid, is only very finely striated transversely. The whorls are five in number, convex above, separated by a deep suture and very gradually increasing in breadth. The last whorl is widest somewhat above the centre and then evenly rounded into the space of the umbilicus; near the mouth it is strongly deflected being at the angle of deflection somewhat constricted. The aperture is conse-

quently nearly parallel to the horizontal plan of the basis, facing the same; the outer peristome is largely expanded and reflexed, its margins being connected by the inner lip of about the same thickness. No dentition is perceptible in the interior of the aperture, although it may exist farther inside, whence the rock could not be taken out. The specimen, being unique and so far complete as to be easily recognised and characterized in its principal features, is too valuable, to sacrifice it to the examination of the inner space of the aperture. The lateral portion of the outer peristome is in the specimen a little corroded.

As regards general form and number of volutions, our specimen recalls much the European *Anch. holoserica* Studer.

Locality. Near Ninnyoor: the single specimen occurs in pinkish limestone.

Formation. Arrialoor group.

3. Anchistoma Arcotense, *Stoliczka.* Pl. I, Fig. 7.

A. testa discoidea, planorbulari, supra planâ, subtus late umbilicata; anfractibus quinis, angustissimis, lente crescentibus, supra convexis, sutura profunda junctis, omninis in umbilici spatio conspicuis, centralibus (1½) levibus, politis, ceteris transversim oblique costulato-striatis, striis lateraliter atque infra tenuioribus seu obsoletis; ultimo anfractu supra quoddam prominente, prope medium altitudinis latissimo, ad umbilici marginem rotundate angulato, antice parum deflexo; apertura obliqua, semielliptica, lateraliter angustiore; peristomate exteriore parum dilatato, expanso et vix reflexo, prope medium unidentato; labio calloso.

Height of shell: transversal diameter (taken as 1·00)	0·35
Width of one whorl above: transversal diameter	0·21

A planorboid shell, consisting of five volutions, being laterally much narrowed, higher than broad, convex above and separated by a deeply impressed suture. All the whorls are visible in the space of the umbilicus, which is very large and the margins of which are, on the last whorl, slightly angulated. The greatest width of the whorls is near to, but still a little above, the middle; the central or embryonal whorls, comprising about one and a half volution, are slightly elevated above the somewhat immersed plane, shining and smooth; the others are covered above with pretty strong oblique striæ, which disappear below. The last whorl is not much deflected; aperture oblique, semi-elliptical and according to the size of the whorls higher than broad. The outer lip is expanded, strongly reflexed and inside, somewhat below the middle, provided with a short pointed tooth; the inner lip is callose, only partly visible on our specimen, the adherent rock preventing a view into the interior space. This makes it uncertain whether any other dentition is present or not. We must await other materials for this purpose; although, save a small portion of shell-surface near the mouth, our specimen is quite perfect.

This species, which is very like the South-European *H. (An.) anigyra*, Ziegler, is readily distinguished from the former by its narrower whorls and the less deflected anterior portion of the last.

Locality. N. E. and close to Alundanapooram, where the single figured specimen was found in sandstone.

Formation. Trichinopoly group.

II.—Macrocyclis, *Beck.* 1837.

Macro. testa planorboidea, depressa, late umbilicata, tenui: anfractibus celeriter crescentibus, ultimo prope aperturam sæpius inflato atque deflexo; apertura subrotundata, peristomate tenui, marginibus labro approximatis antice paulum expanso atque reflexo.

As restricted to the depressed forms with a thin shell, the genus *Macrocyclis* seems to admit of tolerably good characteristics, although specimens, which are not in every way perfect, may be easily confounded with *Zonites* and others. H. and A. Adams quote besides *Macrocyclis* four subgenera, which in part include rather different forms with strong and consistent shells, thickened peristome and not umbilicated; it seems necessary, that these should be separated. The species of *Macrocyclis* are chiefly inhabitants of the East.

We notice one species from the South Indian cretaceous deposits, *M. carnatica.*

1. Macrocyclis Carnatica, *Stoliczka.* Pl. I, Fig. 8.

M. testa planorbulari, tenui; spira immersa, late umbilicata; anfractibus quaternis, rotundatis, supra atque subtus omninis conspicuis, transversaliter minute striatis: striis supra fortioribus; apertura rotundata.

It is not without hesitation, that we venture to name specifically such an imperfect specimen as that figured. There seems to be no very serious objection as to its generic determination, although it exhibits some affinities to *Nanina*, which genus is, as Mr. W. Blanford informs me, by far more numerously represented throughout India, than has been usually supposed. The planorboid form, however, making all the whorls visible above and below is rather foreign to true Naninæ. The specimen is accidentally so much injured by pressure, that it is not easy to determine the very exact shape in the roundness of the whorls, so as to fix the specific characters. The shell is quite depressed, coiled in nearly a regular plane with slightly immersed spire and with a perfectly open umbilicus, so as to make all the whorls visible below and above. The whorls are only four in number, increasing rapidly in width, and covered densely with transverse striæ. These are oblique, somewhat stronger above than laterally and below, and slightly bent forward on the outer periphery. The whorls themselves are roundish, having their greatest width above the middle, and being apparently less convex above than below. The specimen has not got the aperture preserved, but it could have been only very slightly enlarged, as traces of the peristome were lost in cleaning out the specimen.

Locality. Near Veraghoor, in soft reddish coloured sandstone.

Formation. Arrialoor group.

Order, PROSOBRANCHIA, *Milne Edwards.*

CHARACTER.—*Gastropoda with conical or spiral shells, present even in the first stage of growth; larvæ with deciduous cephalic fins; gills placed in front of the heart; sexes distinct.**

By far the larger number of the PROSOBRANCHIA are provided with an operculum, of which the structure and the position in the aperture are very important for all purposes of classification. Without exception, they are inhabitants of fresh or salt waters, although several species can, for a shorter or longer time, live outside of this medium in a moist atmosphere; and a few possess even an air-breathing organ, besides the gills.

The PROSOBRANCHIA are proportionally more numerous than any other order of the Gastropoda. This fact is equally true as regards the fossil, as the living species, which are, so far as our knowledge extends, nearly equal in number.†

Fossil species of PROSOBRANCHIA occur from the lower Silurian upwards through the whole series of the sedimentary deposits. Their solid shells usually admit of a good preservation in the fossil state; while the fact, that they are chiefly inhabitants of littoral waters of moderate depth, renders the study of this order of very great importance to the palæontologist. A knowledge of the PROSOBRANCHIAN fauna alone is sometimes sufficient to enable just conclusions to be drawn, as to the conditions, under which the materials, which once buried and now enclose these fossil shells, have been deposited.

We have already observed, that it appears desirable to separate from the order PROSOBRANCHIA, the POLYPLACOPHORA and the NEUROBRANCHIA. Excluding these, we shall have then to deal with the three next divisions, CTENOBRANCHIA, ASPIDOBRANCHIA and CYCLOBRANCHIA, of which the second may rather be replaced by three others proposed by Gray—SCUTIBRANCHIA, SCHISMATOBRANCHIA and DICRANOBRANCHIA. The South Indian cretaceous rocks have yielded species in nearly all these divisions; and, according to the arrangement already adopted, we begin with the highest, the

Sub-order, Ctenobranchia.

CHARACTER.—*Prosobranchia with usually spiral shells, animal with the respiratory cavity on the neck containing one well-developed comb-like gill, rarely with a second gill in a more or less rudimentary state: the males have usually strongly developed external copulative organs.*

The CTENOBRANCHIA, in this sense, comprise the greatest portion of Cuvier's PECTINIBRANCHIA, and are generally divided into SIPHONOSTOMATA and HOLOSTOMATA. Although far from being a natural grouping, this division is unquestionably in many

* Some of the adherent genera, like *Tenagodus, Siliquarius, Vermetus* and others, are necessarily, from their mode of living, *Hermaphrodites.*

† Characteristics and descriptions of so-called new species of shells are published almost daily, but occasionally this is done in such a way, that it needs no serious apology from any conchologist, for having been unable to decipher the true character of some of the new species. Mere outlines of casts of usually richly ornamented shells certainly can be only of very limited local value. The publication merely of specific names for sake of priority is never justifiable.

respects preferable to that of PROBOSCIDIFERA, TOXIFERA, ROSTRIFERA, &c., because, if we depend on this single character of dentition, groups otherwise very closely allied are totally separated from each other.* To the palæontologist also, who has principally to deal with the shells only, and but very rarely with the animals, the first mentioned division is—no doubt only for the present—of far greater use, while he could scarcely take the desirable advantage of the other system in classifying his fossil remains.

Keferstein† distinguishes in the two divisions of the SIPHONOSTOMATA and HOLOSTOMATA a number of smaller groups, depending on the variations in the dentition of the radula, as the indefatigable labours of Drs. Gray, Troschel, Lowen, Mörch and others have made them known. It is certain, that these differences in the plaits or teeth of the radula, and their connection with the food and general living of the animal form a very important character in the classification: it would be quite an exception in this, as compared with the other classes, if they did not. Still so much remains to be done in this direction, as we have already noticed, that Keferstein's sub-divisions into TÆNIOGLOSSA, RACHIGLOSSA, &c., offer disadvantages similar to those presented by Adams' higher divisions. They widely separate families, which are closely allied in every respect save the dentition: so widely indeed, that even a partially natural arrangement from lower to more highly organized forms is unobtainable. We shall not enter further upon the discussion of these divisions depending on the dentition, but shall simply quote the families in what we believe to be their respective relations to each other, for which we shall endeavour to give more detailed proofs. We cannot pretend to call this arrangement more natural than many others. Our only reason for adopting it is, that in our present case of describing a *local cretaceous* fauna it appears to be more suitable for our purposes than that adopted by Keferstein (loc. cit.). As regards families and sub-families, which will be referred to, we must state in each individual case, in what sense these divisions are to be understood.

Tribe, Siphonostomata.

The CTENOBRANCHIA included in this tribe have usually a small head with either a proboscis or a long rostrum, and with a respiratory sipho of different lengths, sometimes represented by a siphonal fold only. The shells are convolute, involute, or coiled up into a conical spire. Depending on the development of the respiratory sipho, the aperture is either provided on the anterior termination with a canal, or is simply a little produced and notched. The operculum is sometimes wanting; but usually it is present, of horny or often of lamellose structure. Nearly all the species inhabit the sea and they are mostly carnivorous, feeding upon other mollusca or similar animals.

Geologically speaking, the SIPHONOSTOMATA are younger than the HOLOSTOMATA. Of the former, several families scarcely appear in deposits of date earlier than ter-

* This point has been most recently discussed again by Mr. Crosse (Journal de Conchiliologie, 3me. Ser. Vol. VI., p. 216, 1866), contesting the value of the dentition as the only or even principal base of classification in Mollusca.

† Bronn, Klassen und Ordnungen des Thierreiches, Vol. III, p. 1030, &c.

tiary, although this restriction to tertiary beds is not by any means so close as was formerly thought by palæontologists. In the Lias the SIPHONOSTOMATA constitute perhaps five per cent. of the Gastropoda, as compared with the HOLOSTOMATA. After that period, however, their number increases rapidly, and they soon overpower the latter to a large extent, being more numerous in the present seas also.

Under this tribe we shall describe the following families in the order here quoted. Some of the last named are by other conchologists transferred to the HOLOSTOMATA. Our reasons will be found stated with the families farther on.

1.—*Family ALATA* (comprising the *STROMBIDÆ* and *APORRHAIDÆ*, or as proposed *STROMBINÆ, TEREBELLINÆ, APORRHAINÆ*).
2. „ *CYPRÆIDÆ* (*CYPRÆINÆ* and *OVULINÆ*).
3. „ *OLIVIDÆ* (*OLIVINÆ* and *ANCILLARINÆ*).
4. „ *DOLIIDÆ*.
5. „ *CASSIDIDÆ*.
6. „ *PLEUROTOMIDÆ* (*CLATHURELLINÆ, CLAVATULINÆ* and *PLEUROTOMINÆ*).
7. „ *CONIDÆ*.
8. „ *VOLUTIDÆ* (*MARGINELLINÆ, VOLUTINÆ, VOLUTOMITRINÆ, MITRINÆ*).
9. „ *FASCIOLARIDÆ*.
10. „ *MURICIDÆ* (*FULGURINÆ FUSINÆ, MURICINÆ*).
11. „ *TRITONIDÆ*.
12. „ *COLUMBELLIDÆ*.
13. „ *BUCCINIDÆ* (*PHOSINÆ, NASINÆ, COMINELLINÆ, BUCCININÆ*).
14. „ *PURPURIDÆ*.
15. „ *TRICHOTROPIDÆ*.
16. „ *CANCELLARIDÆ*.
17. „ *TEREBRIDÆ*.
18. „ *PYRAMIDELLIDÆ*.
19. „ *CERITHIOPSIDÆ*.
20. „ *CERITHIIDÆ*.

I. *Family. ALATA.*

In taking advantage of this early name of Lamarck we do not intend to express by it more than the simple meaning the word itself indicates, namely, the general resemblance among the different forms of the shells in this family as regards the *expansion of the outer lip*. This was Lamarck's first idea, when establishing the family, and so far as any practical advantage is concerned in the determination of shells only, we believe, this general idea has not been yet superseded. Much, however, has since then been done in the examination of the animals, and, depending on the differences

which had been observed, two families were proposed: (a) *Strombidæ*, with *Pterocera*, *Strombus* and *Rostellaria* as the chief genera; and (b) *Aporrhaidæ*, with *Aporrhais* and *Struthiolaria* (and probably *Priamus*), to which Gray adds *Trichotropis* and others (possibly better separated into a distinct group). Now viewing the similarities and the differences of the two families, we see them to be both Rostrifera in the sense of Gray* (Guide to Mollusca, 1857, page 64), that is,

Siphonostomata with an annulated rostrum, subulate tentacles with the eyes on their outer side, and the teeth in seven series: three on either side being respectively of similar form. The mantle has its edges more or less expanded and lobed; the gills are pectinate; the operculum is annular, ovately elongated, rather thin and horny: the shell is fusiform, turrited or more ovate, the whorls internally compressed, narrow, and the outer lip always somewhat expanded in adult age.

The principal differences recorded in the anatomy of the animals, exist in the *locomotive organs and the tentacles.* In *Strombus, Pterocera, Rostellaria* (considering these genera in the old sense of Lamarck) the foot is divided into two parts, the posterior being more or less prolonged, slender, and bearing on its termination a claw-like operculum. The eyes are on prolonged peduncles, which have the tentacles on the internal side, that is to say, *morphologically*, the eye-peduncles and the tentacles seem to be grown together for a longer or shorter distance. The tentacles are often longer than the peduncles in *Rostellaria*, and nearly of equal size with them in *Pterocera.* In *Terebellum*, the forepart of the divided foot is very small and the hinder part very prominent and thick. The tentacles are usually said to be wanting, and the eyes to be on the ends of very long peduncles. Gray questions the first point, and it is, we think, very probable, that further researches will prove, that the tentacles are united, or grown together with the eye-pedicles throughout their entire length. This ought, at least, to be anticipated from a morphological point of view.

Aporrhais (*Chenopus*, Phill.) has the foot not divided, but somewhat compressed, and, although truncate in front, still somewhat produced; the eyes are sessile on very short peduncles, which are united with the very long subulate tentacles at the base only. Gray (teste Clark) says (Guide to Mollusca, page 75) the "*A. pes-*
"*pelicani* creeps slowly; but the organs do *not appear adapted for progressive move-*
"*ment.* It is shy, and whether the shell is placed with the aperture upwards or
" downwards, it does not usually commence creeping by pushing out the foot anteriorly
" like other Gastropoda, but often twists the *long neck and foot to the caudal extremity*,
" and there fixing it, with a sudden spring effects the turning of the shell." It is obvious, that this kind of movement is quite similar to that of *Pterocera* or *Strombus*, except that the divisions of *foot* and *caudal extremity* are not so evidently separated, as in those two groups of shells.

The foot of *Struthiolaria* is thick, small and oblong, more adapted for *fastening* than for creeping. The tentacles are of moderate length, and the eyes are on small bulgings outside near the base.

We see thus, that in the different alterations in the form of the foot and the eye-pedicles there is a transition and connection, rather than a strict separation. The

* This author proposes for the *Alata*, excluding *Aporrhais* and others, but including *Onustus* and *Phorus*, the name of Leptopoda, on account of the divided foot and the manner of moving about.

simple ovate foot of *Struthiolaria* is *elongated, laterally compressed* in *Aporrhais, partially divided* in *Terebellum*, and *entirely divided into two separate lobes* in *Rostellaria*, &c. The same might be said as regards the eyes; the *small bulgings* at the base of the tentacles of *Struthiolaria* are replaced by *short pedicles* in *Aporrhais;* these pedicles are *prolonged* (and probably united with the tentacles throughout their entire length) in *Terebellum;* while in *Rostellaria*, and others, they are usually *separated* from the tentacles near the termination, where the eyes are placed on the former. It is true, that other Gastropoda shew similar relation in the same points, and still are regarded as belonging to different families; but it must be remembered, that they do not agree in all the other similarly or more important characters, which we have previously noticed. Taking all these facts into consideration, it must be granted, that the structure of the animals does not lend itself very favorably to such a separation into two families as has been proposed by Adams, Gray and others. There would be far less difficulty experienced in this matter by accepting Adams' proposition of the two sub-families of STROMBINÆ and TEREBELLINÆ, and by adding to these his family APORRHAIDÆ as a sub-family APORRHAINÆ, although I actually do not know, whether even this separation is necessarily called for. Supposing, however, that it were so, the distinctions between these sub-families would be those which I have specified regarding the foot and the eye-pedicles, while the other points of relation, quoted above, would form the character of the family.

These questions could all be easily settled, had we to deal with the living species only, but what is to be done with the immense number and great variety of fossil forms? To determine these with equal correctness, we ought to have distinctions in the form of the shell, equally characteristic with those we have noticed in the animals themselves. And if, as is often the case, we cannot determine with sufficient accuracy the genus, how difficult it must be to retain sub-families! Chenu consequently recognized only one family, the STROMBIDÆ, containing seven genera and a few sub-genera. In a general view this appears to be, provisionally, the best way: but the number of genera in living and fossil species must be enlarged, and those so-called sub-genera as much as possible avoided. At the same time, it cannot be questioned, that our object ought to be to endeavour to prove the existence of similarities and differences of the shells, in accordance with the results obtained from a careful examination of the animals, rather than to obliterate or ignore these on the supposition that they never existed before. It may be a very plausible conjecture, that these *distinctions did not exist at some remote period*, as some of our most able palæontologists are ready to believe, but we must first point out, at least approximately, what that period was. Nor can we ever establish this, until we carefully and gradually trace back these relations from the recent into the older formations. We shall recur to this point when speaking of *Alaria* and *Aporrhais*.

In treating of the different genera of the ALATA, it will not be necessary to go beyond what is justified by the material we have before us in describing our cretaceous fossils. To discuss these points fully would require a thorough knowledge of all the species both living and fossil. It is undoubted, that there are great difficulties in determining the distinctions of the sub-genera as proposed by H. and

A. Adams, but most probably any other would offer equal difficulties, and, at present, there seem to be no other possible means of distinction than some artificial one, as proposed by Adams and others.

Fossil forms of *Alata* are first known, with full certainty, from the Lias (certainly middle, if not lower), and they continue numerously represented through all subsequent formations, but unfortunately are very rarely met with in good preservation. The cretaceous deposits are extremely rich in species belonging to this family. A nearly complete list of these species will be found in Pictet's "Paleontologie Suisse 3me. Ser." As to geographical distribution, the largest number is known from Europe, especially from the southern part. The American deposits are comparatively very poor in species of the *Alata*, equally as in those of the *Volutidæ*. The fact is in accordance with the representation of these families at the present time.

The South Indian cretaceous deposits have yielded us a tolerably good number, represented by 15 species, which will be found described under five genera; *Pugnellus contortus*, Sow.; *P. granuliferus*, Stol.; *P. uncatus*, Forb.: *Aporrhais Arrialoorensis*, Stol.; *Ap. securifera*, Forb.: *Alaria Parkinsoni*, Mant.; *Al. papilionacea*, Goldf.; *Al. glandina*, Stol.; *Al. acicularis*, Stol.; *Al. tegulata*, Stol.: *Rostellaria? palliata*, Forb.; *Pterodonta terebralis*, Stol.; *Pt. bulimoides*, Stol.; *Pt. nobilis*, Stol., and *Pt. Ootatoorensis*, Stol.

We commence the descriptions of the Prosobranchia with the family *Alata* not because they are the most highly organized of this order, but rather on account of the difficulty of bringing them into the general scheme, if we began with any other family. Our only object here, as already stated, is to shew the relations of the different families, genera and species, as composing a local fauna. It is true, that maturity reached at a later period and division of different functions on separate organs are generally signs of relatively higher organization; the locomotive organs are also higher developed than in most other families of Gastropoda. The eyes of the *Alata* are nearly quite as perfect as those of Cephalopodes and Fishes, and the separation of tentacles and eye-peduncles, in a large number of species, could be looked at equally as a sign of higher organization, for this division is principally developed in the Pulmonata.

I.* PUGNELLUS, *Conrad.* 1860.

Pug. testa ovata, ultimo anfractu plus minusve involuta, crassa, strombiformi; apertura angustata, interne lævigata, marginibus continuis; labio callosissimo, postice accumulato atque sæpius spiram tegente; labro ad marginem crasso, posterius lobato: lobo plus minusve unciforme prolongato; canali anteriori incurvo.

The genus *Pugnellus* was first proposed by Conrad (Journ. Acad. Nat. Sc. Phil. IV, p. 284) for four species, *P. densatus*, Con. from Mississippi, *P. tumidus*, Gabb, from Chili (subsequently described in Proc. Acad. Phil. for 1860, p. 197, Pl. 3, Fgs. 13 and 14), and the South Indian *Strombus uncatus* and *contortus* of Forbes. Gabb has recently described two characteristic species from California (Pal. of Calif.

* Genera are numbered continuously in each order; the species in each genus.

1864) *P. hamulus* (l. cit. p. 124, Pl. 20, Fig. 81, and Pl. 18, Fig. 48) and *P. manubriatus* (l. cit. p. 125, Pl. 29, Fig. 229). This number is now increased by only one additional species from South India, *P. granuliferus*.

All the seven known cretaceous species agree in the characters mentioned above, and constitute a tolerably well defined small group. This must evidently be classed next to *Strombus*, forming in some respect a passage between the subgenera *Monodactylus* and *Gallinula*,* but differing from both in the very strong development of the callosity of the apertural margins and the *incurved* anterior canal. In all the three species, which we describe and of which we are in possession of good specimens, there is between the hook-like prolongation of the wing and the strong anterior notch a second slight insinuation of the margin, exactly similar to that of *Str. canarium* or *Str. japonicus*, which circumstance makes it almost impossible to separate *Pugnellus* far from these living species of *Strombus*.

The *Pug. uncatus* appears first somewhat different from the other species of *Pugnellus*, and is in general habitus more allied to species attributed to *Gallinula*, than to any of the other forms known. In comparing, however, the shells closely it is seen, that the mode of growth of the outer lips is exactly the same, the transverse ribs being curved in the same way, as in *P. contortus*, excepting that the angle, where the margin is bent, is only strongly thickened and produced,† while in the other species it is prolonged into a hook-like lobe. Another difference is the pointed termination of the canal and the broad insinuosity of the outer lip next to it: the former is only a consequence of a smaller development of the callose margin, which however is not wanting, and is in character exactly the same as in the two other species; the latter is a somewhat more marked difference, and is to be found of exactly similar shape in a few *Rostellariæ* and especially in *Hippocrene* Montf., of which the eocene *Hipp. macroptera*, Lam. is considered as a type. A most noticeable fact is the great difference which exists between young or imperfect specimens of *Pugnellus* and those of full growth and perfect preservation, as may be seen by a comparison of the numerous figures on our Pl. III.

The genus is as yet restricted to the above-mentioned seven cretaceous species.

1. Pugnellus contortus, *Sow. sp.* Pl. III, Figs. 1—5.

1846. *Strombus contortus*, Sow., Forbes in Trans. Geol. Soc. Lond. VII, p. 129, Pl. 15, Fig. 9.
1850. *Colombellina contorta*, D'Orb. Prod. II, p. 231.
1860. *Strombus contortus* (not cortortus), Sow. Journ. Acad. Nat. Sc. Philadelphia, IV. p. 284 (vide Pugnellus).
1861. *Pugnellus contortus*, Sow. sp. Gabb, in Proc. Amer. Phil. Soc., Vol. VIII, p. 128.
1864. *Columbellina contorta*, D'Orb. Pictet, Mat. p. l. Pal. Suisse, Foss. Ste. Croix, 3me. ser. p. 671.

Pug. testa elongate-ovata, spira brevi, acuminata, angulo 60°-65°; *anfractibus senis, convexis, spiraliter obsolete-striatis, duobus ultimis transversaliter costulatis: costulis in ultimo anfractu flexuosis, antice versus evanescentibus, atque sæpius prope marginem exteriorem in medio convexitatis tuberculis terminantibus; apertura ovali,*

* Is also a genus of birds.

† Since our figure on Pl. III was prepared, another larger and more complete specimen has been procured, on which the prolongation is much stronger.

angusta atque elongata, interne lævissima, marginibus conjunctis, callosissimis, partem ventralem testæ omnino tegentibus; labro antice valdè insinuato, posterius lobato: lobo hamiformi, crasso, contorto, lateraliter compresso, acute terminanti, supra infraque canaliculato; labio crassissimo, callum ovalem elevatum formante; rostro callose-marginato, lato, interne canaliculato, intorto, supra sæpius incrustato seu prope marginem exteriorem subcanaliculato.

The general form of the shell is elliptical, somewhat elongated in the direction of the axis. There are usually six whorls present, forming a spire with an angle varying from 60 to 65 degrees; they are convex, the uppermost very distinctly and densely striated in a spiral direction; these striæ become afterwards nearly obsolete. On the penultimate whorl slight transversal costæ appear, which on the last whorl are flexuous, partly and gradually disappearing towards the anterior canal, while others placed nearer to the outer margin do the same, or terminate in more or less elevated turbercles, corresponding with the hook-like prolongation of the outer lip. On perfect specimens, the majority of which measure about 30 mm., the last whorl occupies usually a little more than three-fourths of the total height. The aperture is elongated-eliptical, being internally much narrowed by the callosity, which thickens and unites both margins. Some of our specimens exhibit on the callose mass round the aperture a kind of purple colouring, which partly seems to be original, resembling that of several living *Strombidæ*. On the posterior part of the outer lips, between one-fourth and one-half the distance from the suture, the callose margin projects into a hook-like lobe, this being turned upwards, contorted towards the aperture, laterally more or less compressed, often so much as to form a sharp ridge on the ventral side; internally and externally it is canaliculated by slight furrows, which, however, often quite disappear under the coverings of the thickened lip. Near the anterior extremity the outer peristome is very deeply insinuated. The canal is slender in proportion to the last whorl; it is bounded like the outer peristome all round with a thick margin, curving inward at the same time; the internal furrow, which seems to have been produced by the elongated sipho, remains always distinct up to the termination, while the exterior one, which marks the place where the two thickened margins join, becomes often obliterated under the numerous layers of the callosity. The inner lip is exceedingly thick and forms on the ventral side an oval large mass of enamel-coating, the last or newest layers of this mass extend sometimes over the entire surface of the shell, with the exception of a small upper dorso-lateral portion.

There is not much variation in the form of the shell of this species, except that the last whorl is sometimes more, sometimes less inflated or gibbose. The hook-like lobe of the outer lip is occasionally less contorted, but somewhat more bent outside. The stronger or lesser development of the callosity causes all these differences and gives the shell often a totally different aspect. Specimens, on which the inner and outer callose mass has been lost, make quite the impression of being a *Fusus* or some allied genus. We have given figures of several of these forms and refer here to the explanations which accompany the plate (vide figs. 2—5).

Pug. manubriatus, Gabb (Palæontology of California, Vol. I, p. 125) is probably more allied to this species than it appears to be from Mr. Gabb's figure (loc. cit. Pl. 29, Fig. 229), and I would not in the least be surprised, if both were found to be identical. In Fig. 229 the traceable suture shews, that the callosity was not present in its entire thickness, and the want of the same near the anterior extremity seems to prove, that this has been partly injured. We possess several specimens with such diminished thickness of the inner callosity, and with the incurved termination of the anterior canal broken away; in this state our specimens do not exhibit any very remarkable distinctions from Gabb's figure.

Localities. N. of Alundanapooram (very common), Kolakonuttom, Serdamungalum, Anapaudy, Monglepaudy, Seraganoor, E. of Illpagoody in Trichinopoly district.

Formation. Trichinopoly group, of which the described species seems to be a very characteristic fossil.

2. Pugnellus granuliferus, *Stoliczka*. Pl. III, Figs. 6—8.

Pug. testa ovata, crassa, spira brevi, angulo circiter 75°; anfractibus quinis vel senis, convexis, transversaliter granulato-costatis, una serie granorum crassiorum prope marginem suturalem sejuncta, spira vix quintam partem totius altitudinis occupante; anfractu ultimo posterius transversaliter oblique costulato, ad medium spiraliter granulato, antice sublævigato et multo angustiore; apertura ovali, elongata, antice angustata, interne lævigata, callosissima, marginibus callositate conjunctis; labro posterius prope medium uncinato: unco crasso, contorto, posticé extenso, lateraliter compresso, infra plus minusve acuto, interne atque externe canaliculato; labro antico profunde insinuato; rostro prolongato, crasso, lente exterius contorto, terminatione incurvo, intus canaliculato, extus medio impresso seu furcato: impressione sœpius callositate fere obsoleta; labio callosissimo, accumulato, spiram fere totam tegente.

As regards the form of the shell, this species agrees in every way with that of *Pug. contortus*, to the description of which we refer in its greater details. The differences consist in size and ornamentation.

All the specimens of *Pug. granuliferus* are even in the first stage of age thicker and more ventricose, and they grow to a much greater size, the usual height in the direction of the spiral axis being 40 mm., and the width including the hook-like lobe somewhat more than 30 mm. The aperture is anteriorly a little narrower, the canal somewhat more contorted and the insinuation in front of the lobe deeper, as in *P. contortus*.

The ornamentation consists from the first volutions in oblique transverse costæ and in spiral sulcations, which sometimes produce a more or less regular granulation. One row of such coarse granulæ is always separated near the suture. To this uppermost row follow transverse ribs, which occasionally are represented by elongated roundish tubercles only. On the last whorl a few slight sulcations cross the ribs, which at about one-fourth or usually one-fifth of the distance from the suture, as compared with the total height of this volution, are cut off by deep spiral sulci, so as to form six to ten rows of smaller or larger, rounded or flat, and more or less

isolated tubercles or granulæ. On the anterior and much thinner portion of the last whorl, which is produced into the canal, the surface is usually so much covered with the callosity, that it appears quite, or to a great extent, smooth.

It would not be easy to find two forms, which remind one more of merely sexual differences, than the *Pug. contortus* and *granuliferus* and still, if the differences are so remarkable and constant, we cannot do else, than distinguish them by specific names. In the description of the former species, I have remarked, that on the first whorls spiral striation or sulcation is quite distinctly traceable, and that it becomes more or less obsolete on the following and especially on the last whorl; in all cases, it is at least indicated: if we wanted to go a little further, we could justly say, it is merely exaggerated in some abnormal specimens, which are here noticed under *P. granuliferus*. Quoy and Gaimard, Soutelet and several other conchologists have noticed, that the female shells of Mollusca exceed those of the male sex very often in size, being usually more inflated or ventricose. It appears to me more likely, that we have to deal here with such a difference of forms, rather than with two animals actually different as regard species.

For imperfect specimens the reader is referred to the explanation of Figs. 6 and 7, Pl. III.

Localities. Kolakonuttom, Andoor, N. and S. of Serdamungalum, S. E. of Anapaudy, in the Trichinopoly group; W. of Illpagoody, Shillpagoody and Veraghoor, in the Arrialoor group. In all these localities of the Trichinopoly district *Pug. granuliferus* is not very common and comparatively much rarer than *Pug. contortus*, of which about eight specimens occur to one of the former. The quotation of the Arrialoor group is probably not so very important, the localities being chiefly near the boundary of these two groups, and on the other hand Mr. Blanford himself states, that their separation is, in the southern portion of the Trichinopoly district, generally uncertain.

Formation. Trichinopoly and Arrialoor groups.

3. Pugnellus uncatus, *Forbes, sp.* Pl. III, Figs. 9—13.

1846. *Strombus uncatus*, Forbes in Trans. Geol. Soc. Lond. VII., p. 129, Pl. 13, Fig. 16.
1847. *Strombus semicostatus*, D'Orbigny, Voy. Astrolabe et Zelée, Paleont. Pl. 2, Fig. 38.
1850. *Colombellina uncata*, D'Orbigny, Prod. II, p. 231.
1860. *Strombus uncatus* (Forb.) Conrad, Journ. Acad. Nat. Sc. Phil. IV. p. 284 (vide Pugnellus).
1861. *Pugnellus uncatus*, Forb. sp. Gabb, in Proc. Am. Philo. Soc. VIII. p. 128.
1864. *Columbellina uncata* (D'Orb.) Pictet, Mat. p. l. Paleont. Suisse, Foss. Ste. Croix. 3me. ser. p. 67.

Pug. testa ovate-ventricosa, antice atque postice attenuata, spira quartam partem totius altitudinis testæ elevata, angulo 65°—75°; *anfractibus quinis vel senis, convexis, sutura impressa junctis, prioribus spiraliter dense-striatis, striis in ultimo anfractu obsoletis; ultimo anfractu transversaliter costato: costis flexuosis, antice evanescentibus. Apertura angustata, ovali, postice sub-rotundata, antice acuta, intus lævigata, callosa; labro incrassato, in alam brevem atque rotundatam seu angulatam postice extenso, extus lamelloso, parum reflexo, intus lævi, antice atque postice insinuato; labio crasso, calloso, in ætate adulta infra atque lateraliter spiram incrustante; rostro extus contorto, acute terminanti, incurvo, intus canaliculato, callositate marginali tenui instructo.*

Shell ovate, pointed at each end, consisting of five or six convex volutions, the last of which is the most ventricose occupying about three-fourths of the total height of the shell. The upper whorls are densely covered with fine spiral striæ, which do not seem to increase in number with the breadth of the whorls, but they become gradually more distant and are nearly obsolete on the last whorl. This one exhibits transversally strong flexuous ribs, originating at the suture and disappearing gradually on the anterior portion, where they are often replaced by striæ of growth only, and in which case the spiral striation assumes again a little more distinctness. The outer lip is much thickened, expanded into a roundish or angulated wing, inside smooth and somewhat reflected, having a sharp margin; exteriorly it shews a kind of lamellar structure; anteriorly and posteriorly it is insinuated. The posterior insinuation is rather deep, but the exterior margin is simply rounded or angulated and always somewhat more thickened, not, however, prolonged into a hook, as in the two other species of *Pugnellus*. The inner lip is in both equally thick, callose, covering the preceding whorl nearly totally (Fig. 10). The canal is thin, contorted, terminating with a sharp point and bent inwards. The callosity of both margins extends over it, but it becomes much thinner here, and covers chiefly the exterior surface. This pointed form of the canal, and the want of a hook-like lobe on the outer lip, combined with the slight but broad anterior emargination are the principal and characteristic distinctions of this species from the two others. Specimens devoid of the callose covering and of the wing are nearly smooth and resemble a *Buccinum*, as Prof. Forbes remarks, or still more a *Phasianella*.

Even the imperfect and cast specimens of this species are easily distinguished from those of the other species by their gradual, not abrupt tapering or contraction towards the anterior termination of the canal.

Localities. W. of Parchairy and W. of Kullygoody; E. of Anapaudy and near Arrialoor. At all these localities the species is not very common; the first three are in the Trichinopoly, the fourth in the Arrialoor group, of the Trichinopoly district.

Formation. Trichinopoly and Arrialoor groups.

II. APORRHAIS, *da Costa*. 1778.
III. ALARIA, *Morr. & Lyc.* 1854.
IV. ROSTELLARIA, *Lamk.* 1799.
and allied genera.

By far the greater number of conchologists agree in the application of the name *Rostellaria* to the fusiform, chiefly smooth, species with a long anterior and short posterior canal, and a moderately expanded, entire or slightly digitated wing, having near the canal one distinct sinuation. The *R. rectirostris* and *fusus* are known as the best examples. The cancellated species with a short canal have been partly separated by Agassiz as *Rimella*, and there are numerous fossil tertiary and cretaceous forms, which belong to this group. The fossil species with a very large wing and a short pointed canal, as *R. macroptera* and others, belong to *Hippocrene*, Montf.

Conrad established for a few North American eocene species another group under the name of *Calyptrophorus* (vide Journ. Acad. Nat. Sc. Phil., Vol. IV, Pl. 47, Figs. 21 and 29). The shell is very slightly ornamented, as in true *Rostellariæ*, the spire nearly totally enveloped in a callose mass, the wing small and simple, the anterior canal straight and of moderate length. *Calyptrophorus* would seem to connect *Rostellaria* and *Hippocrene*, agreeing with the former in the form of the wing and canal, and with the latter in the large development of the callosity. Gabb (in his Catalogue, Proc. American Phil. Soc. VIII, p. 98) refers the Indian cretaceous *Rost. palliata* of Forbes to *Calyptrophorus*. This does not seem, however, to be fully justified for the present. Mr. Conrad does not show in his figures of *Calyptrophorus* any posterior canaliculation on the aperture, while in our species this is very distinctly marked. This character is essential to all species of *Rostellariæ*, being dependent upon the existence of a certain filamentous organ, somewhat similar to that of *Oliva* and allied genera. We shall notice subsequently under the description of the species, that the aperture of *R. palliata*, Forbes, appears to have been anteriorly only effuse or notched, and if any canal was really present, it must have been very short indeed. The only very similar form, that we have been able to trace, is the *Rostellaria lævigata*, Melleville (Ann. des sc. geologiques etc. par Riviere, II. 1843. p. 117, Pl. X, Figs. 10—11). In Melleville's original figure there is apparently no sign of incompleteness of the specimen observable, although this seems to have been rather considerable, when we compare with it Deshayes' figure in his last publication (Anim. s. vert. d. bassin de Paris, III, p. 460, Pl. 90, Figs. 5 and 6). M. Deshayes' representations of the single complete specimen, which he had obtained, named *R. sublævigata*, D'Orb.* shews, that the species possessed a short anterior canal. In any case, whether our cretaceous form had only an anterior notch or emargination (as is supposed in our restored figure), similar to that of many *Pterodontæ*, or whether it had a short canal, which is almost quite as probable, there is certainly for the present no sufficient reason to separate the species generically from the smooth *Rostellariæ*. Better materials will of course settle this little difference very easily.

A number of fossil species, which are generally described under the three names prefixed to these notes, offer moreover a far greater difficulty than the allied forms

* It seems impossible to trace this name of D'Orbigny from the "Prodrome," namely, from the edition (in three volumes) bearing date 1850-1852, and I am not aware of any other. It is true, that Sowerby designed in 1832 a young shell of *Alaria (Rostellaria) costata (vide* Stoliczka in Sitzungsb. Akad. Wien. 1865, Vol. LII, Revis. p. 66), with the name *R. lævigata*. This name was evidently selected first by Sowerby and communicated to Sedgwick and Murchison, who published the same in the list accompanying their paper on the "Structure of the Eastern Alps;" vide Trans. Geol. Soc. Lond. 2d. Ser. vol. IV, p. 419. Subsequently Mr. Sowerby changed, for some reason or other, this name into *R. læviuscula*, which is to be found in the "Explanation of the plates" attached to the same volume of the Transactions. So far as I can make out, Mr. D'Orbigny was acquainted only with the second name of Sowerby and knew in the Prodrome no other, than Melleville's (Deshayes ? !) *R. lævigata*. I have stated elsewhere, that Sowerby's names *R. lævigata* and *læviuscula* have no signification in reality, and as the species, of which they are fragments, is not a *Rostellaria*, in the sense in which it appears desirable to restrict the genus, I do not know whether the change of Melleville's original *R. lævigata* is at all necessary. Certainly the reference, which Deshayes quotes in his "Paris fossils" p. 460,—1850. Prod. de pal. t. II, p. 315, No. 322,—is not to be found in that place.

known as *Rostellaria*.* Excluding *Pterocera*, to which usually the more inflated shells with a broad digitate wing are referred, the remainder of the Liassic and Jurassic species of the *Alata* are generally, since the publication of Morris and Lycett's "Fossils of the great oolite," described under the generic name *Alaria*. The most recent publication on this point is the supplement to D'Orbigny's 'Paléontologie Française,' Tom. III. Gastropoda. Piette, who undertook the description of the Siphonostomata, restricts the genus *Alaria* to those species which have no posterior canal and generally a narrow wing: *Chenopus (Aporrhais)* to others with a posterior canal and broader and less digitate wing. Pictet very justly remarks (Mat. p. l. Pal. Suisse, 3me. Ser. p. 588 etc.), that it is impossible to keep up this kind of distinction; but he acknowledges certain peculiarities in the Jurassic species only, and to these he would restrict the name *Alaria*, placing all the other cretaceous forms under *Aporrhais*. This, however, cannot stand, as we shall have occasion to notice further on, although we fully agree with Pictet's views in general, and have, therefore, endeavoured to shew the similarity in the fossil forms by adopting the family name *Alata*.

I have myself referred the largest number of the species of the same group, from the Alpine Gosau-formation to *Alaria*†. This passing from one extreme to the other, and the widely differing controversies of different writers, are sufficient signs of the very unsettled state of the question, as to what genera should be accepted. In the following description of the species, I have partially adopted Piette's views, but at the same time I have endeavoured to combine with the characters, mentioned by the French author, others, which appear of great importance.

It is well known that young specimens of *A. pes-pelicani* have no posterior canal, and that this becomes developed in fully grown specimens only. But if at the same time we examine the shell of the species we have just noticed, we find that the callosity, which is secreted in the aperture by the mantle, is totally different from what we see in *Rostellaria*. The body of the animal is very thin, depressed, and it is only the margin of the mantle which expands. The anterior canal is in no way different from the other digitation of the wing, and the callosity does not extend upon the upper surface of the wing, but forms exteriorly a sharp edge. The inner lip is strongly thickened, accumulated, not extending beyond the under surface of the shell, while, in *Rostellaria*, the callosity appears to be more equally distributed in thin layers over the greater portion of the spire, and not uncommonly over the whole shell. Another very marked distinction is the length and the interior space of

* It is scarcely necessary to notice the unjustifiable application of names such as *Gladius*, or even *Fusus*, to *Rostellaria*. Undoubtedly it is not right to ignore old names for the sole reason that they had been neglected by subsequent authors. But when these old names have been chiefly applied in a certain loose sense, and never had afterwards any certain restricted signification, they are and must be justly rejected. Such is the case with *Gladius* and *Fusus*, but not with *Aporrhais*, which had a strict application before *Chenopus* was introduced, probably only because *A. pes-pelicani* cannot easily be mistaken for any other living species. Gabb in his Catalogue (loc. cit p. 109) hastily referred all the cretaceous species, which had been described under *Rostellaria* to *Gladius*, but in his most recent publication (Palæontology of California, p. 124) he re-adopts, in accordance with the generally received views, *Rostellaria* again. Such uncalled for changes are not to the benefit of science.

† Sitz. Akad. Wien. 1865, Bd. II, Revision etc. p. 65.

the canal. I have consequently referred only those species, in which I have been able to observe such marked callosity—differences in the aperture and the canal to *Aporrhais*, and have left the others provisionally in *Alaria*. I am quite aware of the weakness of this point; still I cannot think it right to consider all distinction as *á priori* impossible, and thence to unite all under the genus *Aporrhais*, as has been done by Professor Pictet. My chief reason for not doing so, is my fear lest by this system all chance of progress in a classificatory knowledge of the numerous fossil *Alata* should be cut off. It is, for example, difficult to understand, that species like *R. carinata*, Mant. or *Anchura abrupta*, Conr. ought to be brought into closer alliance with *Aporrhais*, than with *Rostellaria*. They differ from both, but I should say more from the former than from the latter. The genus *Alaria* must be in some way restricted, and cannot be retained either in the sense in which it was introduced by Morris and Lycett, nor as lately commented on by Piette. Chenu classed *Alaria* with *Pterocera*, but very different forms appear to be represented in it, allied to *Rostellaria*, *Pterocera* and *Aporrhais*. Deshayes in the last issue of the Coq. foss. de Paris, Tom. III. p. 438 also entertains the opinion, that *Alaria* (certainly in part) is more allied to *Rostellaria* than to *Aporrhais (Chenopus)*.

I have repeatedly gone over all the fossil species known to me, and it is, I think, impossible to come at the present to any satisfactory arrangement. Much may be expected from good materials, since scarcely one-tenth of the species, known up to the present, have been obtained in a perfect condition. Still, for a long time to come, nothing but an artificial division will answer; I mean, a division based more upon one or other single character, than upon the totality of the structure and form of the shells. The following may serve as an attempt, at least in one direction, though I confess I myself look at it for the present partially hopeless of success, and I do not like, therefore, to carry it out.

These remarks refer principally to the forms, which have been formerly noted as *Aporrhais* or *Rostellaria*. The relations between the latter genus and *Pterodonta* will be noted subsequently in detail.

1*st*.—To restrict the name *Alaria* to the species with a simple undivided and narrow wing, as the Jurassic *Al. hamus*, Desh. and *Al. rhinoceros*, Piette and Desh.

2*nd*.—Species, which have the exterior termination of the wing extended in two opposite directions (as *Rost. carinata*, Mant.), and possess a long anterior canal, could form a small group, designated by Conrad *Anchura*.*

3*rd*.—Broad winged shells with only a single point to the posterior external termination, as *Rost. Orbignyana*, Pict., or *Rost. papilionacea*, Goldf. might be distinguished under a separate name.

* Jour. Acad. Nat. Sci. Philad. IV, 284, Pl. 47, Fig. 1. Conrad's characteristics are very closely specified and restricted to the single species, which he describes.

All these three forms are generally ornamented with transverse ribs.

4th.—Species with slightly dilated wing, soon dividing into two or three long extremities, carinated and usually spirally striated whorls et cet.—as the long known *Al. myurus*, Desh. or *Al. lævigata*, Morris, might be referred to *Tessarolax*, Gabb.*

5th.—To retain under *Aporrhais* only those species, which have a broad dilated wing from the base, terminating exteriorly in as many points, as there are keels on the exterior side of the wing, which ought in all cases to extend to the exterior margin of the wing, as in *Ap. Dupiniana*, D'Orb. or *Ap.* (Chenopus) *atractoides*, Desh.

6th.—The Jurassic *Diarthema paradoxa*, Desh. forms a separate genus, somewhat allied to *Ranella*.

7th.—*Spinigera* of D'Orbigny ought probably to be classed here better than with *Ranella*.

The genus *Eustoma*, Piette, will be mentioned hereafter in the CERITHIIDÆ; its position is at present uncertain.

Through a limitation of *Aporrhais* in this way we evidently come into *Pterocera* and *Strombus*, when such a review becomes nearly exhausted, and would again suggest considerable alterations.

I have already stated, that it is not through the living species of *Strombus* and *Pterocera*, that these great obstacles are produced, but through the large number of the fossil so-called *Pterocera*, which give so little hope of an early and successful classification. The difficulties, however, become insurmountable, should such an unnecessary separation be acknowledged, as has been proposed by the creation of the families APORRHAIDÆ and STROMBIDÆ. The length of the canal or mantle-fold cannot form a very important distinction, for the canal is quite as short in many true STROMBIDÆ, as it is in *Aporrhais* or *Struthiolaria*. The form of the rostrum in the animals of the two last named genera is no doubt quite similar to that of many CERITHIIDÆ, but the different genera of this family show also a similarly considerable variation in the form of this organ (see *Vertagus*, *Cerithium*, *Telescopium*, *Triphoris* and *Cerithidea)*, if perhaps not to the same extent, as the ALATA. H. and A. Adams state, (loc. cit. p. 281) that especially the fossil forms indicate strong affinities of *Aporrhais* with *Cerithium*; I confess, that I am not aware of any fossil forms such as would support a separation of this kind. Where affinities have been pronounced as existing between the two genera, it was, and still remains to a great extent, to be shewn, whether these had not arisen merely from the incompleteness of the fossil species of the ALATA. Many of the older secondary species of CERITHIIDÆ exhibit great relations to some species of the TROCHIDÆ and many *Chemnitziæ*, but they cannot be generally mistaken for *Aporrhais* or other allied genera.

* Palæont. of California, 1864, I, 126, Pl. 20, Fig. 82.

II. APORRHAIS, *da Costa*, 1778.

1. APORRHAIS ARRIALOORENSIS, *Stoliczka*. Pl. II, Fig. 1.

Ap. testa acute-ovata, anfractibus septenis, convexis, minute cancellatis; ultimo spira altiore, supra medium acute-, infra sub-carinato, spiraliter striato; apertura angustata; canali anteriore brevi, posteriore spire usque ad apicem decurrente; labro parum expanso, digitato (?), ad marginem crassiore, reflexo, extus acuto.

Shell oval, pointed on each end, composed of seven convex volutions, which are ornamented with spiral and slightly curved transversal striæ, the latter being somewhat stronger. The last whorl is higher than the spira, inflated and provided above the middle with a stronger and below it with a smaller keel, both of which form probably small points or digitations on the outer margin of the aperture; spiral striæ are numerous above and below the keels, between them only one is present. The anterior canal is short pointed, much thickened internally and slightly bent inwards at the point of termination. The aperture is very much narrowed by the thickness of the lips, as is generally the case in other species of this genus. The outer lip is not much expanded, terminating in one or more probably in two points; its margin is somewhat reflected, showing a slight sinus near the anterior canal; the posterior canal is prolonged up to the apex of the spire being annexed to the previous volutions.

Locality. Comarapolliam near Ootacod: the figured specimen is unique, and unfortunately little portions of the exterior margin of the aperture have been lost in preparation; the extent of the wing has been restored in its probable shape.

Formation. Arrialoor group.

2. APORRHAIS SECURIFERA, *Forb. sp.* Pl. II, Figs. 2—4.

1846. *Rostellaria securifera*, Forbes, Trans. Geol. Soc. Lond. VII., p. 128, Pl. 13, Fig. 17.
1850. „ „ D'Orb.; 1861, *Gladius* id, Gabb; 1864, *Aporrhais* id, Pict. et Camp.

Ap. testa spira elongata, turrita, anfractibus numerosis, ad medium subangulatis, convexis, costulis transversalibus spiralibusque ornatis iisque plus minusve granulosis; ultimo ad medium carinato, subinflato; labro in alam angustam uncinatam, postice curvatam extenso; apertura angusta, interne callosissima, lævigata; labio accumulato, crasso; canali antico atque postico brevi.

Spiral angle 25°—28,° sutural angle 8°—10°.

A turreted shell consisting of numerous whorls, which are more constricted on the upper than on the lower suture and ornamented with transverse and spiral ribbings. On the uppermost whorls the transverse ribs are usually much stronger, being slightly curved and crossed by fine spiral elevated striæ. These latter increase on the next whorls much more rapidly in strength than the former, and being elevated on crossing these they easily produce the appearance of continued rows of tubercles. When at the same time the transversal ribs become somewhat obliterate, these tubercles appear more isolated. There is nearly every possible transition to be observed between the continued and smooth ribs and single isolated rounded tubercles. The

number of transverse ribs is nearly constant, 15 in one volution, and that of the spiral, 7 or 8 on one whorl. Of the latter the upper three are more distant from each other and usually stronger, the lower 4—5 are thinner and much more closely placed to each other. There are sometimes exceptional cases met with, in which the lower striæ are of equal strength with the upper (vide Fig. 3), or where the upper become even nearly obsolete, while the lower continue in their strength. When the shell surface is completely preserved, it is also covered with a very fine spiral striation.

The last whorl is somewhat inflated, in circumference triangularly gibbose and near the middle provided with a strong keel, which is tuberculose or nodulose: the nodules being produced by a stronger development of the transverse ribs; the keel continues, however, smooth on the wing-like prolongation of the outer lip. The aperture is considerably narrowed from the great callosity of the interior of the lips. The posterior canal is short, not extending usually beyond the antepenultimate whorl. In none of our specimens is the anterior canal preserved, it could not, however, have been long, and is probably complete in the figure given by Professor Forbes (loc. cit.), according to which we have restored it in outline in our Fig. 2, Pl. II. The wing is simple and narrow, turned upwards or posteriorly, internally canaliculated in its entire length and externally keeled near the upper, or concave margin. Between the wing and the anterior canal there are two insinuations of the margin, being separated by a small pointed prolongation of the same, so as to form a second small wing.

There cannot be a question, that Professor Forbes' figure, referred to above, represents only a fragment of a very large specimen, being mostly devoid of shell-surface (vide Fig. 4, Pl. II.). We have observed, that on similar large specimens the ornamentation often becomes near the aperture more or less obliterate, although it does not disappear without leaving traces of roundish tubercles. Prof. Forbes says, that the surface appears to have been quite smooth, but that it was not, is distinctly seen in his figure, which shews the three upper spiral striæ as impressions on the interior side of the uppermost whorl.

Ap. securifera bears, as regards ornamentation and general form, a great resemblance to *Rost. Requieniana* (D'Orb. Pal. Franç. Ter. cret. II. p. 293, Pl. 209, Figs. 3 and 4). The spiral striation of the latter does not seem to have been well preserved on the specimens, from which the figure was restored; but that it could not have been wanting on the lower or anterior portion of the younger whorls is sufficiently proved by its existence on the last. It is difficult to say, until actual specimens have been compared, that they are identical, but certainly it appears very probable, that they do not belong to actually different species. The *Ap. granulata*, Sow. sp. (Zekeli, Gosau-Gastropoda, Pl. 12, Figs. 3, 4, 7 and 8: *Alaria* id. Stoliczka, Sitzungsb. Akad. Wien. Vol. LII, p. 67) differs merely by its posterior canal being prolonged to the apex and by some of the transversal ribs being at intervals considerably thickened. It belongs undoubtedly to the same group of species of *Aporrhais*.

Localities. Kolakonuttom, N. of Serdamungalum, N. of Alundanapooram, E. of Anapaudy, Andoor, N. E. of Koloture; Olapaudy, Arrialoor and Karapaudy.

Formations. Trichinopoly and Arrialoor groups, only the three last named localities refer to the latter; the species is far more frequent in the first named group.

III. ALARIA, *Morris & Lycett*, 1854.

1. Alaria Parkinsoni, *Mantell*, Pl. II, Figs. 5—8.

1864. *Aporrhais Parkinsoni*, Mantell. Pictet Mat. p. 1., Pal. Suisse, 3me. ser. Foss. Ste. Croix, 2d. pt. p. 604. with synonyms and references to other authors.

Al. testa elongata, turrita; anfractibus numerosis convexis, primis 3—4 *lævigatis, cæteris transversaliter costulatis, spiraliter striatis: costulis circiter* 18 *in uno circuitu, parum curvatis atque obliquis, utrinque attenuatis, nonnullis rectis, varices quoddam fortiores representantibus, in ultimo anfractu paucioribus atque prope marginem exteriorem gradatim evanescentibus; striis numerosissimis, nonnullis prope suturam posteriorem fortioribus atque distantioribus; ultimo anfractu subinflato, gibboso; rostro moderate-longo, acuto; labio calloso, partem inferiorem ultimi anfractus tegente; labro alato; ala lata, brevi, postice intus ad anfractum antepenultimum decurrente, ad marginem exteriorem acute uncinata atque in utroque latere unci insinuata, antice ad peripheriam angulata atque rursus late insinuata.*

Spiral angle 28°—32°, sutural angle 8°—9°.

Pictet gave in his 'Paléontologie Suisse,' such a thorough critical examination of this species, that it is scarcely necessary to add any thing to the knowledge of its literature. A comparison of our figures with those already existing will shew, that the form of the shell and of the whorls, together with their ornamentation and the wing, are in every way so exactly identical with the European species, that no remarkable difference can be traced out.

The first three or four, probably embryonal, whorls are quite smooth, with a polished surface (Fig. 7). They seem to become filled out by growth with a solid mass of shell-substance, inasmuch as they disappear altogether on the cast of the shell (vide Fig. 5). The perfect shell seems to have been covered with a thin coat of callose mass, obliterating somewhat the finer ornamentation on the surface. The last whorl including the anterior canal is about one-fourth longer than the spire (vide Fig. 5). As regards the wing, our specimens, so far as they are complete in this point, resemble much more the English figure in "Geol. Trans. IV., Pl. XVIII., Fig. 24," than that of Pictet in his 'Gres verts;' the differences arise probably much more from the imperfectness of the specimens, than from being actual variations, although both may be accounted for, especially as in all the species of the *Alata* the form of the wing so much differs with their age. It would no doubt be very interesting to know whether such a variation does exist, and whether it is to that amount admissible within the limits of the species. If it be, then a very close comparison appears necessary of the specimens known as *R. Parkinsoni* with *R. Reussi*, Geinitz. The figures given by Reuss and that of Woodward (Geologist 1861? Pl. XI. Fig. 1) show the only difference in the anterior margin of the wing. I need scarcely repeat, that the wing in *Pterocera*, *Rostellaria* and others attains its perfectness only very

gradually, and that it does not develope itself equally in different specimens of even the same species. Some specimens of *Strombus* or *Pterocera* have their wing perfect, although being scarcely of half the size of others which have it not. I rather think it probable, that *R. Reussi* is not different from *R. Parkinsoni*.

Localities. Neighbourhood of Odium and Moraviatoor, S. of Serdamungalum, S. E. of Monglepaudy, in Trichinopoly district.

Formations. Ootatoor and Trichinopoly groups.

The references as to the occurrence of the species in Europe agree as to its belonging to the middle cretaceous strata, specially the Gault.

2. Alaria papilionacea, *Goldfuss, sp.* Pl. II., Figs. 9 and 10.

1844. *Rostellaria papilionacea*, Goldfuss, III Petr. Germ. Gast. p. 18, Pl. 170, Fig. 8.
1847-1862. „ „ Reuss, Geinitz, Müller, Pictet, etc.

Al. testa elongata, conica; anfractibus 8—9, *subconvexis, transversim costatis, ad suturam posteriorem spiraliter numerosissime striatis, ultimo anfractu spira longiore; rostro brevi; ala simplici, crassa, postice ad marginem interiorem anfractui penultimo adherente, ad exteriorem subacuta, antice rotundata, parum insinuata.*

Spiral angle 32°—38°, sutural angle generally 8°.

In Goldfuss' original figure of this species the wing is more sinuous on its anterior margin, but all subsequent authors agree, that this sinuosity is not so strong, and it appears, that the slightly different shape has been produced by pressure injuring the specimen. Our specimens as regards form are perfectly identical with the figures of Reuss (Böhm. Kreidef. 1845, Pl. 9, Fig. 6) and Geinitz (Char. Pl. 18, Fig. 8, and Verst. v. Kieslingswalde Pl. 1, Fig. 11). The specimens from the German Quadermergel and Plæner are mostly casts, and their whorls appear, therefore, to be much more convex than they actually are. Well preserved specimens of *Al. papilionacea*, when compared with *Al. Parkinsoni*, appear to have a much thicker shell, smaller number of ribs in one volution (12—16), and usually a shorter spire with a larger angle. The surface is usually smooth, covered with a layer of callosity, except on the uppermost whorls, which are finely striated. The striæ near the upper or posterior suture are also a little stronger, but they are much more numerous than in *Al. Parkinsoni*. The transverse ribs are distant on the last whorl, forming elongated tubercles on the convexity and being obsolete near the suture and on the wing itself.

Localities. E. of Anapaudy, Andoor, Coonum, Koloture, Kolakonuttom, Shutanure, N. of Serdamungalum, N. of Alundanapooram; N. of Karapaudy, Permapolliam, S. W. of Nulloor, in Trichinopoly district.

Formations. Trichinopoly and Arrialoor groups; to the latter the three last named localities belong, and the specimens procured are only very few in number.

The species is pretty common in Europe all through the middle cretaceous beds of Northern Germany, from Lemberg in Galizia into Hanover. It has not, I believe, been recorded from any place south of the Alps, nor from England.

3. Alaria glandina, *Stoliczka*. Pl. II, Figs. 14 and 15.

Al. testa acute-elongata, anfractibus numerosis, ad suturam posteriorem sensim constrictis, lævigatis, transversaliter costulatis: costulis acutis, obliquis, 8—12 in uno circuitu; spira ultimo anfractu (sine canali) longiore; ala simplici, falcata, postice ad peripheriam uncinata, acuta, interne anfractui penultimo affixa.

Spiral angle 32°—35°, sutural angle 8°.

The whorls are rather numerous in this species, when compared with its size, and are much constricted on the upper suture. The transverse ribs, which differ from 8—12 in number, are oblique and obsolete next the upper suture, similarly as in *A. papilionacea*, but they are always much sharper. No spiral striation is perceptible in any of our specimens, which are well preserved on the exterior surface. The anterior canal has not been seen perfect, but it could not have been of greater length than is indicated in the outline, and, including the last whorl, it had about the same height as the spire, consisting of all the preceding whorls. The wing is prolonged posteriorly into a rather long point and anteriorly simply curved towards the canal. Only a very slight sinus seems to have been present between the canal and the wing.

The small number and the form of the transverse ribs of the whorls combined with the shape of the wing distinguish the Indian species without difficulty from *Al. costata*, Sow. of the Gosau deposits (Zekeli, t. XII. Figs. 1 and 2, Stoliczka, Sitzungsb. Ak. Wien. LII, p. 66) or from *Ap. Robinaldina*, D'Orb. (Pict. Mat. Pal. Suisse, Ste. Croix, Pl. 92, Figs. 9 and 10.)

Localities. N. of Alundanapooram, E of Anapaudy.

Formation. Trichinopoly group.

4. Alaria acicularis, *Stoliczka*. Pl. II, Figs. 16 and 17.

Al. testa conica, aciculari; anfractibus numerosis, subplanis, transversaliter costulatis, spiraliter minutissime striatis, callositate plus minusve obtectis atque politis; ultimo anfractu subinflato, spira breviori; rostro brevi (?), labro expanso, postice ad anfractum penultimum affixo.

Spiral angle 35°—40°, sutural angle 5°.

This little form seems to be occasionally nearly as much covered with an enamel coating as the *Rost. palliata*, with the exception, that the covering is more equally distributed over the entire surface of the shell. The whorls are nearly flat, separated by slight impressions, which mark the sutures. The apex on well preserved specimens is perfectly covered, and the ventral or front side of the shell equally so. Where the coating is thinner transversal ribs in rather an oblique position, and a very fine spiral striation, are perceptible. The last whorl is somewhat convex, shorter than the spira, subangulated below, and apparently anteriorly produced into a short pointed canal only. The outer lip is expanded, reaching posteriorly not above the previous volution; its margin has not been seen preserved. This species resembles greatly *Ap. acuta*, D'Orb. (Mat. p. 1. Pal. Suisse, Ste. Croix, II. p. 597, Pl. 93, Fig. 1), which differs by somewhat higher whorls and proportionally a greater

length of the last. Similar characters, combined with a greater spiral and smaller sutural angle separate the species now under description from *A. tegulata*, n. sp.

Locality. Olapaudy, in an oolitic, ferruginous rock; rather rare.

Formation. Arrialoor group.

5. Alaria tegulata, *Stoliczka*. Pl. II, Figs. 11—13.

A. testa spira elongata, acuta, superficie polita; anfractibus 8—10, *subconvexis, transversaliter costulatis; costulis parum obliquis, nonnullis fortioribus interdumque in anfractibus succedentibus continuis; ultimo anfractu circiter dimidium totius altitudinis occupante, ad basim spiraliter striato; rostro elongato (?), tenui; labio calloso; labro expanso posterius uncinato (?), postice nonnunquam supra anfractum antepenultimum decurrente.*

Spiral angle 28°—32°, sutural angle 8°—12°.

The shell is rather elongated consisting of 8 or 10 whorls, which are slightly convex, transversally costulated and covered with a thin enamel callosity. These costæ are usually very thin, sharpened and numerous, only some of them, in about one-third of one volution separated from each other, being somewhat stronger. On the last whorl, which is of about the same height as, or a little higher than, the spire, the ribs become more distant and often disappear altogether. When the shell is not enveloped in the callose secretion it appears to have been all over covered with very fine spiral striæ; on the anterior portion of the last whorl this striation is usually retained. The transversal ribs owe their sharpness chiefly to the covering callosity, which unites them often through nearly the total height of the spire, continuing from one whorl to the other; this makes the sutures nearly obliterate, but they are always traceable by a slight impression.

The rostrum is not entirely preserved in any of our specimens and we have indicated its probable length by an outline. The inner lip is rather callose and the secretion of the enamel-coating seems to proceed from this portion of the mantle. The outer lip is expanded, reaching posteriorly on the penultimate whorl and occasionally little higher; it seems to have been prolonged into a hook-like wing, while anteriorly it is much contracted. This species differs from *A. acicularis* by a greater height of the whorls of which the ribs are not so much oblique, by a smaller spiral and larger sutural angle, and apparently also by a greater length of the anterior canal or rostrum. The numerous ribs, resembling sharp lamellæ, are characteristic of this species, and do not admit an identification with any known species, although when these lamellar ribs are not preserved, the resemblance becomes apparent to several others.

Localities. Andoor, Kolakonuttom, N. of Serdamungalum: Comarapolliam, Arrialoor, S. E. and N. E. of Karapaudy, Olapaudy and near Veraghoor. Except at Olapaudy not common.

Formation. Trichinopoly-(to which the three first named localities refer) and Arrialoor-groups.

IV. ROSTELLARIA, *Lamarck*, 1799.

1. Rostellaria palliata, *Forbes*. Pl. II, Figs. 18—20.

1846. *Rostellaria palliata*, Forbes, Trans. Geol. Soc, Lond. VII, p. 129, Pl. 13, Fig. 15.
1847. *Fusus Fontanieri*, D'Orbigny, Voy. Astrolabe et Zélée, Paléont. Pl. 5, Figs. 6 and 7.
1850. *Rostellaria palliata*, Forb. D'Orb. in Prod. II. p. 228.
1861. *Calyptraphorus palliatus*, Gabb. Proc. Am. Phil. Soc. VIII. p. 98.
1864. *Aporrhais palliata*, Pictet and Camp. Mat. Pal. Suisse. 3me Ser. Foss. Ste.Croix, 2 pt. p. 629.

Rost. testa cuspidiformi, depressa, lævigata atque polita; juniore spira fusiformi, anfractibus planis, contiguis; adulta anfractu ultimo subventricoso, ad basim spiraliter striato; apertura elongate ovata, obliqua, antice (?) atque postice canaliculata; labro parum extenso, extus reflexo, postice callose pronato, spiram fere ad apicem dorso-lateraliter incrustante; labro callosissimo, postice ad marginem intus subdentato, infra atque lateraliter totam spiram cum apice tegente atque canali angustissimo a callositate labri separato.

The young shell of this species, or rather the first whorls of an imperfect shell, consists of about 5 or 6 flat volutions with scarcely impressed suture; the surface is smooth, exhibiting only fine striæ of growth and on the basis of the ultimate whorl a fine spiral striation; the angle of the spira varies from 30 to 35 degrees; on the whole the species in this state resembles very much an *Eulima*, or, when the anterior extremity of the columella is somewhat better preserved, a *Fusus*, for which it was mistaken by D'Orbigny (vide Fig. 19).

Well preserved specimens and usually those of larger size and in advanced age, have the last volution by much the largest and somewhat inflated, but at the same time a little depressed and occupying about one-half or little more of the total height of the shell. This last whorl is equally smooth and polished, or finely striated, like the others.

The aperture is elongated-ovate obliquely placed to the spire with a thickened inner and somewhat expanded outer lip. None of the specimens at our disposal have the anterior portion of the aperture perfectly preserved, but there are no certain indications of a long canal, as has been previously noticed. Most probably the aperture had only an anterior notch the outer margin being somewhat produced, as in the figure of *Rost. lævigata*, Melleville, previously referred to (p. 24).

The posterior canal is very distinct and separates both margins. The outer lip extends posteriorly as a callose band and covers the dorso-lateral portion of the preceding whorl up to near the spire; on the peristome it appears to be single, although not yet observed in complete preservation. The inner lip bears, near the posterior canal, a thick tubercle-like tooth and envelopes in a similar way as the outer lip with its callosity the whole frontal (Fig. 20*a*) or ventral portion of the previous whorls up to the apex, extending over this also on the sides of the shell. There it is considerably thickened and on the dorsal side in its entire extension, beginning at the posterior termination of the aperture, separated by a very narrow canal from the callosity of the outer lip. The lateral thickening of the outer lip

gives the shell a form very much resembling the point of an arrow. Prof. Forbes (loc. cit.) attributed the formation of the callosity solely to the outer lip, which is not strictly the case. In Forbes' figure also the anterior extremity of the last whorl is probably more restored than the actual specimen seems to allow. Only further and better collections of specimens can clear up the doubt existing on these questions.

Localities. S. of Serdamungalum in the Trichinopoly group, out of a blueish calcareous sandstone very similar to that near Pondicherry, wherefrom Prof. Forbes' specimens were procured. S. W. of Mulloor, Arrialoor, N. of Olapaudy, W. and S. E. of Karapaudy, in the Arrialoor group, out of a light-coloured, often somewhat siliceous or ferruginous sandstone.

Formation. Trichinopoly and Arrialoor groups; more common in the latter.

V. PTERODONTA, *D'Orbigny*, 1843.

Tylostoma, Sharpe, 1849. Quart. Journ. Geol. Soc. Lond. Vol. V, p. 376.
Varigera,* D'Orbigny, 1850. Prodrome, Vol. II, p. 103.

Pter. testa ovato-elongata, crassa, superficie lævigata interdumque polita; spira conica seu turritellari; ultimo anfractu subventricoso seu inflato; apertura ovali, intus lævi atque callosa, antice emarginata seu canaliculata; labro parum dilatato, integro, intus ad marginem aperturæ denti-seu varici-forme incrassato, dentibus ac varicibus in anfractibus junioribus ad intervalla sæpissime preservatis.

So many different opinions had been already pronounced upon the nature of the fossils, which we unite under the above name, that we cannot pass over this subject without entering briefly on the history of these shells. At the same time it will be necessary to state the reasons which have induced us to regard two genera, universally believed to be totally distinct, as synonymous. Our remarks will, we trust, also show the necessity of classing the genus *Pterodonta*, as here characterized, in the immediate vicinity of the typical *Rostellariæ*.

* Although there cannot in reality be very much doubt, that D'Orbigny under his *Varigera* meant generically the same shells for which Sharpe proposed the name *Tylostoma*, still it is surprising, that no French palæontologist who has access to any of D'Orbigny's original specimens has thought it worth while to inspect the same and settle every doubt on this point by the publication of a few lines. If anybody reads D'Orbigny's characteristics of *Varigera* (Prodrome, II. p. 103), he cannot help thinking, that D'Orbigny meant under his "varices longitudinales" *external* varices on the shell, for he does not even hint, that the specimens which he examined, were casts. Moreover, on page 68 ibid., he says of *Var. Ricordeana*, "espece oblongue a fortes varices sur une surface lisse." Farther, he compares the varices of *Varigera* with those of *Scarabæus*. The fact is, that *Scarabæus* has very often remains of the margin of the outer lip placed externally on opposite sides, but these remainders are very thin and wear very soon away. I am, however, not aware of any such external traces of the margin of the aperture in any of the species, which have been described as *Pterodonta* or *Tylostoma*. If D'Orbigny had only cast-specimens before him, and if he meant by his varices *impressions of the same*; or if it can be supposed, that he understood these varices to be *internal*, his characteristics immediately become more intelligible; but who can reasonably presume on such essential alterations in the characteristics of a shell? The comparison of the last internal varix of *Pterodonta* with the internal varix near the margin of the outer lip, before it expands, in *Scarabæus* is perfectly correct; there could not be possibly a better comparison selected. It must, however, be remembered, that this varix is absorbed on the preceding whorls and only exists near each renewed apertural margin. There is, therefore, only one varix in *Scarabæus*, not several as in *Pterodonta*!

The *Pterodontæ* are elongated, naticoid shells with a smooth and often polished surface, in appearance identical with that of the living *Rostellariæ*. Besides striæ of growth, the surface usually exhibits a very fine spiral punctuation, which appears to have been caused by the epidermis of the shell in its living state (vide Quart. Journ. Geol. Soc. Lond. 1849. V. Pl. IX. Figs. 4 a and 4 b). This punctuation recalls very much the shell surface of many *Naticidæ*. The last whorl is very often inflated or ventricose, exceeding in height that of the spire, or being equal to it; it is seldom met with shorter than the spire. The aperture is anteriorly notched or produced into a short canal. In one species, the *Pt. elongata*, D'Orb. (Pal. Franç. Crét. Pl. 218, Fig. 2) the canal is turned backwards; in most of the other species the anterior portion is only a little produced and emarginated, or, perhaps in young specimens, only effuse. In a large number of species not even this notch or emargination has been noticed, the specimens being known only from imperfect casts. Sharpe (loc. cit. p. 377), when speaking of *Tylostoma*, which name he proposed for a number of casts belonging to *Pterodonta*, says distinctly, that "they have no canal nor notch to the aperture," although his Fig. 3, on Pl. IX of *Tyl. punctatum* and Figs. 7 and 8 of *Tyl. ovatum* shew clearly, that the aperture *was anteriorly* a little produced, evidently with the effect of forming a short canal, or at least a notch. Further the author very properly notes the "strong analogies" of the specimens determined to be *Tylostoma* with D'Orbigny's *Pterodonta*, but he does not think it worth while going into greater details of these analogies, apparently on the ground of the latter genus belonging "to a very different family of Gasteropods." D'Orbigny, when noting the characters of his proposed genus *Varigera* (Prod. II. p. 103) records simply its relation to *Actæon*, which makes a special reference to a notch or canal unnecessary. By much more important are Pictet's notes on *Tylostoma* (vide Mat. p. l. Pal. Suisse. 3me. Ser. p. 349). He says first, that the aperture terminates anteriorly with an acute angle, which is very evidently shewn in all the specimens figured on plate LXXIII., ibid. After discussing several points of similarity between *Tylostoma* and allied genera, Professor Pictet concludes thus (loc. cit. p. 350);—"la seule modification que l'on puisse citer est, chez quelques espèces, *une faible dépression de l'extrèmité antérieure* de la bouche simulant un *sinus très-peu profond*."* Nothing can be of higher value than these remarks of Pictet and the observations on Sharpe's figures. I may add, that I have examined our Indian materials very carefully, and I find, that in every case, when portions of the mouth are preserved, an anterior notch is distinctly traceable. We certainly cannot be, therefore, very far from the truth, when we conclude, that the specimens usually described as *Tylostoma* all possess if not a distinct canal, at least an anterior notch on the aperture. They can, therefore, without any objection, be classed with the other Siphonostomata.

We come now to the second important point, the expansion and the inner thickening of the outer lip. In three of the species, figured by D'Orbigny, namely, *Pterodonta elongata, ovata* and *inflata*, this expansion is perfectly distinct, entire, but never very considerable; the fourth species, *Pt. intermedia* is an incomplete cast. Expansions similar to those in the first three species are noticed in all the four species

* Italics are ours.

of *Tylostoma*, described and figured by Sharpe, and also in several of the species figured by Pictet (loc. cit. pl. LXXIII.). Two of our species show the expansion equally distinctly. It appears, that this expansion of the outer lip is never wanting in perfect specimens, but on the other hand it is almost certain, that it attains its proper size only after a certain stage of growth of the specimen. Before the expansion takes place the outer lip is provided internally with a strong elongated varix or fold, which narrows the space of the aperture laterally to a great extent. This fold or tooth is either smooth and simple, or it has the internal edge more or less crenulated, as is clearly exhibited in the figures of *Pterod. inflata* and *intermedia*, D'Orbigny, *Tylostoma ovatum*, Sharpe, and others. This inner fold or varix of the outer lip varies extensively in its size. In some specimens it is tooth-like and placed posteriorly, or in the middle, or nearer to the anterior termination of the outer lip; in other specimens it is much more prolonged and extends from the anterior extremity nearly to the posterior suture, that is, across the entire breadth of each whorl. There is every variation to be observed in the different species as regards the size and the strength of this thickening on the outer lip. In young specimens it is less or not at all developed, just as is the expansion of the lip itself. In this state of age the shell of *Pterodonta* cannot be better compared with any other genus than with *Priamus* (*Halia*, Risso). It would be interesting to compare with these forms better preserved specimens of D'Orbigny's *Globiconcha*. From the comparison of a large number of different forms, it appears, that the internal varices had occasionally been again absorbed during the succeeding growth, and that only some of the last ones, or actually only the last near the margin of the aperture, remain unaltered; cast-specimens of shells are especially important for studies of this kind.

It will be readily seen from these notes, that the number or even the existence of the varices or their impressions on the upper whorls cannot be regarded as being of very much value generically or perhaps even specifically. When the varix is tooth-like and anteriorly placed there will never be a trace of an impression seen on the upper whorl, because their lower portions are always covered by the succeeding volutions. This is, for instance, the case in the typical *Pterodonta inflata*, D'Orb. The impressions of the varices *do*, however, exist, in this species as I had occasion to observe on a few well preserved casts, which I broke up for that purpose. In cases where the varices are placed posteriorly, or where they extend close to the posterior margins, their impressions will be clearly observable on all the upper whorls, unless the varices had been previously absorbed. Instances of all these variations may be seen by a comparison of the figures of D'Orbigny's *Pterodonta* and Sharpe's and Pictet's *Tylostoma*, the identity of which can scarcely be doubted from all that is known of their structure at the present.

Having thus treated at length the generic characters and their variations in *Pterodonta*, it remains only to say a few words as regards the classification of the genus among the numerous families of the order Prosobranchia.

Excluding a few fusiform species, to which we shall draw special attention subsequently, we have in *Pterodonta, smooth shells of an oval or conical shape, with*

the aperture anteriorly notched or canaliculated and with an expanded outer lip. It is evident, that these are the principal characters of *Rostellaria* (sensu restricto) and that we do not in the least need to alter D'Orbigny's original proposition as to the classification of his *Pterodonta* in the family *Alata*.

It is difficult to understand what subsequently induced this acute observer to place *Pterodonta* in the neighbourhood of *Actæon* and others. It could only be on account of its evident relationship to *Varigera (? Tylostoma)*, which from the incompleteness of the specimens D'Orbigny was induced to consider to be allied to *Actæon*. Strictly speaking there is, however, scarcely any similarity to be found between *Actæon* and *Pterodonta*, for the punctuation of the surface in the shell of the latter is identical with that of the true *Rostellariæ*, *Conus* and others, but rather different from that of *Actæon*, *Ringicula* and other Opisthobranchia.

According to these subsequent alterations of D'Orbigny, the genus *Pterodonta* (with *Tylostoma* and *Varigera*) has been classed in very different ways. Woodward quotes it next to *Actæon (Tornatella)* in the family *Tornatellidæ*. Chenu places it with *Actæonella* in the *Pyramidellidæ*. Pictet believes, that *Tylostoma* belongs to the family *Rissoidæ* and *Pterodonta* to the *Buccinidæ!*

I confess that I am unable to find any support for any of these propositions.

It is scarcely necessary to remark, that the degree of the expansion of the outer lip and of the prolongation of the anterior canal cannot reasonably be regarded as of very great importance in a classificatory point of view within the limits of the family *Alata*. The genus *Aporrhais* exhibits all these variations in one species, or rather in one and the same specimen during different stages of age. Many *Strombi* afford similar instances, and the typical *Rostellariæ* as well. The canal is scarcely produced in many fossil species of *Rostellaria*, and Deshayes very properly directs attention to these forms as being closely related to *Terebellum* (vide Anim. sans vert. Paris, 1866, Tom III, p. 463). In other species, several of which had been separated under the name *Hippocrene*, the canal is curved towards the face of the aperture. The same is the case with several *Strombidæ* and the genus *Pugnellus* (vide Pl. III). Many species of *Pterocera* have the canal recurved backwards. It is therefore nothing extraordinary or new, when we find several of these variations represented in *Pterodonta;* they may be and are more important as specific, than as generic, characters, unless combined with some other marked distinctions. The figure of the solitary species *Rostellaria Cailliaudi*, Desh. (loc. cit. Pl. XCI, Fig. 3) could, as regards the shortness of the canal, expansion of outer lips and the general form, represent a species of a *Pterodonta* nearly quite as well.

If we look for an analogue of the internal varix of the outer lip, we can find it in *Obeliscus (Pyramidellidæ)*, the larger number of species of which have remains of the internal ribbings of the outer lip preserved for some distance on the upper volutions. These remains are, however, usually very closely placed to each other, and represent the internal striation or plication being often interrupted by furrows rather more than by the formation of separate varices. Another very marked analogy is to be found in Deshayes' figure of *R. Dewalquei*, ibid. (Pl. LXXXVIII, Fig. 18). Deshayes (loc. cit. Tom. III, p. 451) attributes the existence

of this varix or tubercle to an accidental secretion; upon this we, of course, cannot pronounce any opinion, not being in possession of any specimens of this very rare shell. The similarity of the interior varix to that of *Pterodonta* must, however, strike every observer, and we wish, therefore, to draw special attention to this fact. Subsequent researches will, it is to be hoped, throw some more light upon this 'accidental secretion.' As the varix in *R. Dewalquei* is placed near the edge of a greatly expanded outer lip, it is a matter of course, that no trace of its existence could remain preserved on the previous whorls. The distinction of this species from a *Pterodonta* is, therefore, quite evident; still the presence of the tooth offers some analogy.

From all these remarks it is, we trust, tolerably certain, that *Tylostoma* and *Pterodonta* are identical forms, which must be classed in the family *Alata*. Still on the other hand it cannot be denied, that the discovery of new and better materials may call for several changes, and perhaps even sub-divisions, in the genus at present known as *Pterodonta*. I would consider the following point only as one of these probable changes.

Pictet described in his "Fossiles des Grès verts," p. 265, Pl. 26, Figs. 1 and 2, two species *Pterodonta gaultina* and *Pt. carinella*, both of which differ from D'Orbigny's typical *Pterodonta* and the species of *Tylostoma* by their elongated fusiform shell, provided apparently with a long straight canal, but still with internal varices or tubercles on the outer lip, leaving at certain intervals impressions on the casts of the shells. On account of the produced canal M. D'Orbigny referred these two species to *Pterocera* (Prod. II., p. 132), having then changed his original idea about *Pterodonta* and believing in its relation to *Actæon*. M. Pictet at first agreed with these changes (vide Grès verts, p. 549), but lately (Mat. Pal. Suisse, 3me. ser. p. 626) he refers the *Pt. gaultina* to *Aporrhais*, and (ibid. p. 657) the *Pter. carinella* to *Murex*. There have not been any better preserved specimens of these species found, and M. Pictet says, that he considers these changes only as provisional. It would not be in the least surprising, if further materials would show the close relationship of these species to *Pterodonta* and confirm in this way *Pictet's* original determinations. I think it very likely that this may be the case.

Seeley described (Ann. Mag. Nat. Hist. ser. III, Vol. VII, p. 282—283) from the upper Greensand of Cambridge two species *Pterodonta marginata* and *Pt. longispira*. Both are known from casts only, on which, however, the beginning of an expanded outer lip, similar to *Alaria* or *Aporrhais*, is distinctly traceable. The upper whorls are ribbed transversally, and there appears to be a strong impression of an internal tooth or tubercle near the aperture. These tubercles are placed below the median keel, where in other species there is always some kind of an insinuation and contraction of the aperture, generally caused by a thickening of the outer lip. No trace of these tubercles has been as yet observed on the whorls of the spire. Should, however, these two species be proved to belong to *Pterodonta*, they must be classed with the two last named species of Pictet in the same section. A fifth species, which belongs to this same division of fusiform *Pterodontæ*, is figured on our Pl. V,

figs. 6—8. All the specimens are imperfect with regard to the aperture, but the outer lip could not have been very much expanded. The shell, as it appears from single fragments, has been smooth similar to other *Pterodontæ* and *Rostellariæ*.

The number of species of *Pterodonta*, which, as at present defined, has been found chiefly in cretaceous deposits,* is tolerably large. This might be to some extent expected from the well-known great representation of the family *Alata* in cretaceous rocks. In addition to the five species already mentioned, the following are quoted by Pictet under the genera *Pterodonta* and *Tylostoma* (vide Mat. Pal. Suisse. 3me Ser. p. 676 and pp. 358—359). *Pterodonta elongata, inflata, naticoides, ovata, intermedia, pupoides* and *scalaris*, of D'Orbigny; *Pterodonta obesa*, Coquand; *Pterodonta (Tylostoma or? Varigera) Ricordeana, Rochatiana, Fittoni* (rather *Fittoniana*, from the Isle of Wight), *Escragnollensis, Guerangeri (Guerangeriana), Carentonensis* and *Toucasiana* of D'Orbigny; *Pterodonta Torrubiæ, punctata, ovata* (this must receive another name) and *globosa* of Sharpe; *Pt. Laharpi (Laharpiana,) fallax, Villersensis, naticoides* (must receive a new name), *elliptica, depressa* and *gaultina*,† of Pictet and Campiche. *Pter. subinflata*, Coquand, (Geol. and Pal. de Const. 1862, p. 179) has been proposed for the Algerian species, which was first noted by Bayle as *Pt. inflata*, D'Orb. The *Natica patens*, Binkhorst (Mon. Gast. et Ceph. craie sup. de Limbourg. 1861, p. 18, Pl. II, Fig. 1) may very probably be shown to be a *Pterodonta;* certainly it is a strange *Natica* with "labro dilatato, reflexo." *Morris* in his Catalogue (p. 274) quotes a species of *Pterodonta*, allied to *Pt. elongata*, D'Orb., from the upp. Greensand of Warminster, and a species of *Tylostoma* (ibid. p. 285) from the lower chalk of Chardstock. Morris follows D'Orbigny's original proposition, as regards the former genus, but he places the latter in the *Naticidæ*. I have to add here the *Pterodonta crassa*, Schafhæutl, (Süd-bayerns Leth. geognost‡. Leipzig 1863, p. 193, Pl. LI, Fig. 1, named here by mistake *Pleurodonta crassa*). It is a species somewhat like D'Orbigny's *Pt. ovata* in form, but neither in the description nor in the figures are any of the impressions noticed. Still it seems to be a true *Pterodonta*, and the omission of these impressions is probably due to the bad preservation of the specimen. It is impossible to say from Shafhæutl's singular references, whether the species is cretaceous or not, for he confounded every thing.

* The two Jurassic species, which probably belong to Pterodonta, are *Melania gigas*, Thurmann, (Leth. Bruntrutana, p. 84, Pl. VI. Fig. 18) and *Pterodonta corallina*, ibid. p. 84. I do not know where the second species is described.

† It would be premature to change this and other specific names, because the other *Pt. gaultina* (*Aporrhais*, Pictet,) could be placed in another genus or subgenus, or whatever it may be called.

‡ I may be excused, when in the following pages I have occasionally omitted a reference to this publication of Mr. Schafhæutl. I am compelled to do so, because it is impossible for me to make out, which fossils are cretaceous and which are not, and to refer to the former only can be my present object. There is in reality no very great loss, for most of the specimens are badly preserved casts, although occasionally described with the opercula! I should not like to pronounce an opinion on the merit of the geognostical studies, but it is to be regretted, that the valuable results, which could have been obtained from a careful examination of that interesting collection of fossils, have been made so thoroughly unavailable by the singular ideas regarding geognostical formations.

With very few exceptions nearly all the species of *Pterodonta* were found in the deposits of Southern Europe, and of the two found in Algeria, one is identical with a French species. I am not acquainted with a single species from the Alpine Gosau-deposits, and cannot offer the slightest opinion as to the *Pt. toucasiana*, which D'Orbigny quotes as occurring also in the Gosau (Prodrome II. *Varigera* id. p. 221). Perfectly inexplicable remains to me also the ground, upon which D'Orbigny transferred (ibid. p. 221), the *Tornatella abbreviata*, Philippi, to his *Varigera*, in spite of the Gosau shell being distinctly canaliculated in front, and having at least one distinct fold on the columella. *Pictet* (Mat. Pal. Suisse. 3me ser. p. 359) believed it an *Actæonella*, according to *Zekeli*, but I have already shown in my 'Revision of the Gosau Gastropoda' (Sitzungsb. k. Akad. Wien, LII, p. 42), that the species is an *Itieria*, a genus of the *Pyramidellidæ*. In the cretaceous deposits of Northern Europe only very few sporadic species have been noticed. Drescher described lately one (Zeitsch. deutsch. geol. Gesellsch, vol. xv. p. 339, Pl. IX. Fig. 12), which he identifies with *Pt. inflata*, D'Orbigny, although I do not think this identification very successful. The convexity of the whorls is rather different in the two species. The impressions of the internal folds on the upper whorls in Drescher's specimens reach posteriorly nearly to the suture, while they scarcely ever appear traceable on the upper whorls of the original *Pter. inflata;* the inner fold or varix being in this species much shorter. As regards this point, Drescher's specimen shows more close relation to our *Pterodonta Ootatoorensis*. At the same time there is no necessity to be in great haste to find a new name for the German specimen, as it is merely an *incomplete* cast.

I would take this opportunity of calling attention to two species, which occur in the hippuritic limestone near Kutschlin in Bohemia, namely, *Pterocera gigantea*, Geinitz, and *Pt. gracilis*, Reuss (Verst. Boehm. Kreidef. 1845, p. 48, Pl. XI., Figs. 14, 15 and 21). Both have the general form of true *Pterodontæ*, and the shell appears to have been smooth and thick. The latter species has been already supposed by D'Orbigny to be a *Pterodonta* (Prod. II., p. 191), but nothing positive can be ascertained, until the specimens have been carefully re-examined. We may have then within the Mediterranean circle of the cretaceous deposits nearly thirty species of *Pterodontæ*, but I need scarcely repeat, that most of them are known from deficient casts only, and it is very possible, that the discovery of better materials may reduce this number to one-half or two-thirds. I am not aware of any species having been described from the American cretaceous deposits; or from Australia.

The South Indian cretaceous rocks have yielded four species, three of the typical *Pterodonta*, and one belonging to that group of fusiform shells. Two of the fossil species are characteristic for the lowest beds, the Ootatoor group, namely, *Pt. Ootatoorensis* and *Pt. terebralis*; the *Pt. nobilis* occurs in the Trichinopoly, and the *bulimoides* in the Arrialoor beds.

1. Pterodonta (?) terebralis, *Stoliczka*. Pl. V, Figs. 6—8.

Pt. (?) *testa elongata, fusiformi, anfractibus subplanis atque lævigatis; apertura oblique trapezoidali, antice in canalem rectum et moderate longum extensa; labro interne pliciforme incrassato, plica multidentata, ad intervalla impressiones nonnullas in anfractibus superioribus formante; columella solida, biplicata.*

Spiral angle 22°—25°; sutural angle 12°—16°.
Probable height of last whorl : total of shell (consid. as 1·00) 0·21 to 0·23.

An elongated fusiform shell, composed of numerous flattened volutions, the surface of which is perfectly smooth, as seen from fragments of the preserved shell. The last whorl is very much shorter than the spire, exceeding only by a little the fifth part of the total height. The aperture must have had an oblique trapezoidal shape, provided anteriorly with a moderately produced canal. The columella is solid with two very oblique folds, which become almost obsolete at the mouth. Judging from a cast specimen (Fig. 8, on Pl. V.) which appears to be nearly complete, the outer lip seems to have been only slightly expanded. The internal varix was long and provided with about six teeth, the middle ones being the strongest. There are usually three impressions of the former varices traceable on the last whorl, each at one-third distance in the circuit; on the penultimate whorl, there are generally but two of the impressions, and higher up they disappear altogether. This seems to be a similar case to that noted by Pictet in his two species, apparently belonging to the same sub-division of *Pterodonta*.

Localities. West of Odium in a brownish calcareous sandstone, and east of Parchairy in a yellowish arenaceous limestone; rare.

Formation. Ootatoor group.

2. Pterodonta bulimoides, *Stoliczka*. Pl. V, Fig. 5.

Pt. testa exigua, bulimiformi, elongata, apice obtusa; anfractibus septenis, convexis, accumulatis lævigatisque; apertura angulate-ovata, antice paulo emarginata; labro in specimine unico haud expanso, interne ad intervalla costato; columella solida.

Spiral angle about 40°; sutural angle 5°.
Height of last whorl : total of shell (consd. as 1·00) 0·37.

In external shape this small shell recalls very much the form of a *Bulimus* or *Achatina*. Although only eleven mm. high it numbers seven volutions, of which the last one is little more than one-third of the total height. The apex is obtuse, the whorls convex, with strongly impressed sutures, the surface covered with fine striæ of growth. The columella is solid; the aperture oval, pointed on both ends and anteriorly slightly notched. It is evidently a young shell, and we do not wonder, therefore, that the outer lip is not perceptibly expanded. The inner fold-like varices are, however, certainly present, as may be seen by an inspection of Fig. 5 b. on Pl. V. The relative position of these varices could not be ascertained, for it could not be done without the destruction of the unique specimen, the rock, in which it is bedded, being a loose gritty sandstone. From the bulimoid form and the large

number of whorls the species may for the present be easily recognised and compared with other allied species.

Locality. Near Veraghoor in the Trichinopoly district.

Formation. Arrialoor group.

3. Pterodonta nobilis, *Stoliczka.* Pl. V, Figs. 2 and 4.

Pt. testa ovate-elongata, anfractibus circiter septenis, subconvexis composita, ultimo in altitudine spiræ fere æquali, superficie minutissime punctata atque posterius prope suturas nonnullis striis spiralibus ornata; labro ad marginem paululum sinuoso atque expanso, intus variciformi incrassato: varicibus longis, fere ad suturam posteriorem extensis atque $\frac{2}{3}$ in uno circuitu distantibus; labio calloso, lævi; columella in junioribus speciminibus excavata, in adultis vix fissurata; apertura oblique ovata? antice emarginata, postice acuta.

Spiral angle 50°—55°; sutural angle 10°—12°.
Height of last whorl: total of shell (consd. as 1·00) 0·50—0·55.

This species is principally characterised by its elongated form, the last whorl being of equal height or a very little higher than the conical spira. The whorls are moderately convex, the surface of the shell is usually smooth, minutely punctated and posteriorly near the suture provided with a few fine spiral striæ. The last volution is inflated and evenly rounded. The outer lip is slightly expanded, internally with a strong and long varix. On the upper whorls impressions of varices are visible at two-thirds distance on each whorl. The columella is in young specimens hollowed out, but in fuller grown specimens the thickened inner lip covers the opening perfectly (vide Pl. V., Fig. 2). In none of our specimens is the anterior portion of the aperture preserved, and its shape has been, therefore, only indicated by an outline in our figure.

Locality. Rare in the sandstones near Garudamungalum in the Trichinopoly district.

Formation. Trichinopoly group.

4. Pterodonta Ootatoorensis, *Stoliczka.* Pl. V, Figs. 1—3.

Pt. testa late conica, anfractibus senis seu septenis, suturis parum impressis atque fere ascendentibus sejunctis, subconvexis lævigatisque; spira brevi; ultimo anfractu maximo, inflato, ad medium obsolete carinato; superficie minutissime punctata; apertura ovate-elongata, antice emarginata; labro parum dilatato, varicibus internis longis, crassis, pliciformibus earumque impressionibus in anfractibus superioribus interdum fere oppositis.

Spiral angle 60°—70°; sutural angle 2°—4°.
Height of last whorl: total of shell (consd. as 1-00) 0-55—0-60.

A broadly conical shell, composed of six or seven slightly convex volutions, of which the last one is inflated and generally higher than the spire. The surface of the shell is smooth, marked only with fine striæ of growth, and minutely punctated.

An obtuse and slight keel is usually traceable about the middle of the last whorl; if however the casts are not well preserved, the convexity appears to be almost quite uniform. The aperture is oval, oblique and anteriorly distinctly notched. The outer lip slightly expanded, internally provided with a thick fold-like varix. The position of the varices on the upper whorls is very variable. Sometimes they are nearly opposite, and as the entire shell is usually somewhat depressed from front to back, its general shape recalls very much some of the smooth *Ranellæ*, or a *Scarabæus*, neglecting of course the external varices or laminæ. In other specimens the impressions are somewhat more distant than half of a circuit, as may be seen by a comparison of Fig. 3 a, Pl. V. On the uppermost whorls, or respectively in young specimens, the varices do not seem to have become developed at all, and very often, when present, their number and the position are scarcely in two specimens exactly the same and corresponding. The inner lip is callose, leaving a sort of fissure in the columella. I had already occasion to mention (vide p. 41.), that this species agrees far more with one described by Drescher from Germany than with the true *Pt. inflata*, D'Orb., with which it has merely the general form in common.

The species is a very characteristic fossil of the Ootatoor group and comparatively not very rare. It occurs usually in casts which show several variations in the height of the spire and the proportions of the last whorl.

Localities. Neighbourhood of Ootatoor, Odium, Moraviatoor, Monglepaudy, Coonum and Puravoy, in limestones or calcareous sandstones.

Formation. Ootatoor group.

II. *Family—CYPRÆIDÆ.*

The genera *Cypræa and Ovula*, as fixed by Lamarck, are the typical forms of this family. *In general the shells are ventricose, globose, or elliptical: the last whorl embracing totally or to a great extent the former; polished, being covered by an enamel coating; anteriorly and posteriorly produced into a short canal, notched and effuse on both ends or at least at the anterior extremity. The aperture is narrow, linear, extending over the entire length on the ventral side of the shell, with an inflexed outer lip.*

There exists a good deal of difference in opinion as to the genera which ought to be admitted into this family. Usually only the two genera mentioned above, *Cypræa* and *Ovula*, have been quoted, according to Lamarck. *Erato* was for some time not accepted at all, but afterwards was by many conchologists united with this family, as well as the singular genus *Pedicularia*. *Marginella* is by some authors described next to *Cypræa*, while others refer it, apparently more correctly, to the neighbourhood of *Voluta*. Deshayes is strongly opposed to this classification and retains *Marginella* in the *Cyprædæ* (An. s. vert. bas. Paris, 2d. edit. III, 543). H. and A. Adams (Genera, I, p. 263, etc.) have established three families, *Cyprædæ*, *Amphiperasidæ* and *Pedicularidæ*. There are no doubt several distinctions between *Cypræa* and *Ovula (Amphiperas)*,—but apparently not equal to those in other

families, so as to render total separation necessary. The animals of both are in fact so very much alike, that several naturalists formerly suggested to unite them into one genus. The shell offers equally many points of relation, as may be seen from the above references. It appears, that this relation will be sufficiently preserved, if we retain the family *Cypræidæ* as formerly, and in this distinguish two or three sub-families, as suggested by Swainson in his 'Conchology,' namely:—

a. *pediculariNÆ*, with two genera; *Pedicularia*, Swains.—the shell being convolute with lateral spire, the outer lip partly and irregularly inflexed, aperture widened, as long as the entire axis of the shell, without teeth on the inner and very seldom on the outer peristome. There are two or three living species known, which feed mostly on Zoophytes, *Ped. sicula* and *elegantissima*, to which Dr. Gray adds the *Coralliobia fimbriata*, H. Adams (vide Guide, 1857, p. 74). Mr. Sequenza described lately a fossil (miocene) species *Ped. Deshayesiana* (Jour. de Conch, 1865, 3me ser. vol. V, p. 59, Pl. IV, Figs. 1—3). A second genus of this sub-family is *Dentiora*, Pease with the species *D. rubida*, P. from the Sandwich Islands. (Proceed. Zool. Soc., Lond., 1862, p. 240). The principal distinction from *Pedicularia* is the "columella plana vel excavata, intus compressa, *dentata*." I am not aware of any cretaceous species having been reported in this sub-family.

b. *ovulinæ*, being throughout involute shells.

c. *cypræinæ*, being principally convolute and becoming mostly involute with advancing age.

b. *Sub-family—OVULINÆ (AMPHIPERASIDÆ, H. and A. Adams).*

The former genus *Ovula* or *Ovulum*, as adopted according to Lamarck and Sowerby, has been separated by H. and A. Adams into five genera, which appear to be natural and tolerably well defined, namely, *Simnia*, *Volva*, *Ovula (Amphiperas)*, *Cyphoma* and *Calpurnus*, in which order the shells exhibit gradually their relation to the *cypræinæ*.

The ovulinæ are in all their stages of growth perfectly involute shells, more or less pointed on each end and canaliculated or emarginated; covered with a moderately thick enamel coating, generally smooth and polished and rarely provided with a fine spiral striation. The surface is usually white or at least not richly coloured. The aperture extends through the entire length of the transversal diameter of the last whorl, is more or less narrow, and on the inner lip not toothed. The outer lip is reflexed in a smaller or greater degree, and in some genera partly, in others over the entire margin, provided with teeth or a similar kind of striation. On the whole, the *ovulinæ* are not very common shells. H. and A. Adams quote 47 recent species, and Reeve describes in his Monograph of *Ovulum* (Conchologia Iconica, 1865) 39 species, excluding some species of *Volva*.

Neither are the tertiary forms, belonging to this sub-family, numerous, and those which are known,—some nine or ten species,—are by authors usually reported among the rarest shells. They need to be divided into the different genera, of which *Ovula*, *Simnia* and *Volva* appear to be represented. Still by much rarer are the cretaceous species, although D'Orbigny and several authors subsequently endeavoured to revert

the greater number of known *Cyprææ* into *Ovula*. Pictet (Materiaux p. l. Paléont. Suisse. 3me. ser. 1864, 2me. pt. p. 687) quotes in his review of the cretaceous *OVULINÆ* seven species, four European and three Indian, namely—

1. *Ovula Marticensis*, D'Orb. (*Cypræa Marticensis*, Math. 1843) is probably a true *Cypræa* (vide *Cypræa* hereafter).

2. *O. involuta* Pictet et Campiche (*Marginella involuta*, Zek. 1852), has already been asserted by me to be a true *Cypræa* (vide Revision der Gastrop. d. Gosaugeb. in Sitzungsb. Akad. Wien. 1865, vol. LII.).

3. *O. striata*, Zek. was in the same paper referred by me to *Pseudocassis* of Pictet and Camp.; it is as yet known from a single specimen only, and is either a *Pseudocassis* or a *Cypræa*, not an *Ovula* or any other genus of the *OVULINÆ*.

4. *O. cretacea*, D'Orb., is a species as yet of doubtful existence, being based neither upon a description nor a figure.

5. *O. antiquata*, D'Orb., from Pondicherry, figured in the Palæont. of the Astrolabe, is a true *Ovula* and will be described hereafter. *Cypræa Cunliffei*, Forb. must be excluded from the synonyms, as being a true *Cypræa*.

6. *O. Kayei*, D'Orb., is a *Cypræa*, and most probably the old *Globiconcha ovula*, D'Orb., which Coquand showed to be a *Cypræa*.

7. *O. incerta*, D'Orb., is an incomplete specimen of *Cypræa Newboldi*, Forbes.

From these remarks it will be seen that the true number of known cretaceous species of the sub-family *OVULINÆ* is reduced to *one*, which is a true *Ovula*. The *O. cretacea, D'Orb.*, must for the present be left doubtful, whether it belongs to this group at all or not, until it may be possible to ascertain the species intended by D'Orbigny's name.

VI. OVULA, *Bruguiere*, 1792.

Ov. testa involuta, ventricosa, ad extremitates subacuta, subcanaliculata seu lente emarginata; apertura angusta: labro inflexo, interne denticulato seu substriato, labio edentulo.

The uncertainty as to the application of the name *Amphiperas* of Gronovius must prevent its replacing Bruguiere's denomination, which is so thoroughly known to all conchologists. Nor does there seem to be any necessity to alter it into *Ovulum*, Sow. accepted by L. Reeve in his last Monograph of this genus (Conch. Icon. pts. 246 and 247, 1865).

The usually inflated form of the shell, being little produced on both extremities and not distinctly canaliculated, the narrowness of the aperture, stronger inflexion and internal striation or denticulation of the outer lip, and the smoothness of the exterior surface show sufficiently the relations of this genus to the *Cyprææ*, as well as on the other hand they render the separation of *Calpurnus*, *Cyphoma* and *Volva* necessary.

We have to notice only a single species, which has been already in 1847 figured by D'Orbigny from the neighbourhood of Pondicherry. Mr. H. F. Blanford men-

tions in his Report on the cretaceous deposits of Trichinopoly and South Arcot—Mem. Geol., Surv. India, Vol. IV, Pt. I. p. 140—'two or three' species of *Ovulum* and repeatedly in other places quotes the name of the same genus. He undoubtedly adopted here D'Orbigny's views, thinking that the *Cyprææ* described by Prof. Forbes had been correctly re-determined by him as *Ovulæ*. In this, however, Mr. D'Orbigny was totally misled, as I shall have occasion to prove hereafter, affirming Prof. Forbes' determinations.

1. Ovula antiquata, *D'Orb.* Pl. IV, Fig. 1.

1847. *Ovula antiquata*, D'Orbigny, Voy. Astrolabe et Zèlée, Paléont, Pl. IV, Figs. 4—6.
1850. „ „ „ in Prod. II., p. 225 *non Cyp. Cunliffei*, Forb.—*Ovula* idem, Gabb, Pictet, etc.

Ov. testa pyriformi, postice truncate rotundata, antice attenuata, depressa, involuta, lævi atque polita; apertura angusta, antice latiore atque vix emarginata; labro inflexo, arcuate expanso, margine in medio latissimo, ad extremitates gradatim angustiore, intus obsolete denticulato.

The pear-shaped form, being dorso-ventrally somewhat depressed, the curved and in the middle thickened outerlip, and a scarcely perceptible notch at the anterior termination, form the chief characters of this interesting species. The aperture is narrow and widens considerably in the anterior portion. The outerlip is inflexed and becomes much thinner towards each end; the dentition on this is so fine, that it is hardly perceptible. The posterior canal is scarcely marked, the outer lip being only on its posterior termination considerably thinner, although still thicker than in the corresponding place on the anterior extremity; both terminations are very slightly notched. A comparison of our figure with that of D'Orbigny (loc. cit.) will, we think, place the identity of the two beyond doubt. Forbes' figure of *Cypræa Cunliffei* (loc. cit.) is certainly not very clear, but it could scarcely be confounded with the former, as it is evidently far less wide and more cylindrical in its total aspect.

Locality.—S. E. of Arrialoor in the Trichinopoly district, where the single figured specimen was obtained. D'Orbigny procured his specimen at Pondicherry; it is, however, a question, from where it was brought to that place, although Arrialoor beds occur not far off.

Formation.—Arrialoor group.

c. *Sub-family—CYPRÆINÆ (CYPRÆIDÆ, H. and A. Adams.)*

The species belonging to this sub-family consist of *shells, which are either in all stages of growth convolute, or only and usually in the first period of their age, becoming afterwards involute, through a stronger development of the last whorls.* The involution is, however, often caused merely externally by a large secretion of enamel coating, apart from the extent of the last volution, and when it is removed, a more or less distinct spire becomes visible on the shell. In some *Cyprææ* (*sensu restricto*, Gray), which are often distinguished by a thinner shell, the spire remains visible even in full-grown specimens. The enamel covering, which exhibits usually the varied

colours of the different genera, is of the highest importance in the determination of fossil species, because when it is removed the shell receives a totally different aspect. The variety of the striation and tuberculation in *Cypræa, Ovula, Trivia* and others belongs to that enamel coating and usually disappears with this altogether, leaving no trace of its previous existence. The same applies to the dentition of the margins of the aperture.

We may meet with descriptions of *CYPRÆINÆ* in three different stages:

i. Being in a perfect state of preservation, in which case there cannot be any difficulty in determining the genus properly. Up to the present time, we may say, not a single cretaceous specimen has been found in this desirable state. The most complete is a specimen of *Cypræa Newboldi*, of which a representation is given (Fig. 2.) on our Pl. IV, but even this has the enamel surface a little injured, and the dentition of the lips has been partially lost in exposing the surface from the adhering rock.

ii. In recent species of *CYPRÆINÆ* the enamel coating is very closely combined with the shell, and a separation of both offers no small difficulty. It is known that the enamel has been separated by the mantle in successive layers, and that its thickness differs as well in different species, as on different places upon, and in different stages of age of, one and the same shell. When a *Cypræa* has been exposed for a long time to the changes of the climate, and when the shell has often been acted on by different mineral solutions, it is observed that the layers of the enamel begin to separate and fall off partially or totally. This may happen sometimes on the shores of the sea itself, before the specimens are finally buried in the rock; not uncommonly also the enamel may adhere to this more strongly than to the shell, and the latter be deprived of it in being cleared from the rock. In all cases such apparently perfect specimens with the shell—exhibiting usually striæ of growth—must be always very cautiously examined. They do not show generally the slightest trace of dentition on the margins of the aperture, and still appear to be in every way perfect. I am inclined to think that this state of preservation has especially led D'Orbigny and other authors into all those misapprehensions about *Ovula* and *Cypræa*. The enamel is often so uniform with the calcareous rock in colour and texture, that there is actually an impossibility of separating both. I have probably examined a larger number of cretaceous *CYPRÆINÆ* than any other palæontologist, and I know how many hours are often lost in their preparation without any success. A drop of acid does sometimes more than every other attempt; although obliterating the greater part of the surface, it still often leaves some traces of dentition perceptible, if any were present. In preparation with the needle alone, they are often lost without a perceptible trace.

iii. The shell may be perfectly destroyed, and this is, among the known cretaceous species, by far the most common state of occurrence. The species of *Cypræa* and *Aricia* show then generally an elevated spire, while those of *Luponia, Trivia* and others are usually quite involute. We need not be surprised, that several conchologists insisted upon not acknowledging any species, based on casts of the shells only. In some cases casts of shells may no doubt be very instructive, and if properly

handled, they may replace satisfactorily a perfect shell, as impressions of the shells do so generally. In other cases, however, they are of little use indeed, and if they do not admit even generic determination approximately, they ought justly to be rejected.

Among the casts of CYPRÆINÆ this is often actually the case, the thickened shell with its surface being totally removed, we get a smooth cast, which can give the shape of the true shell only approximately. There is one favorable condition to be mentioned, that is, if the aperture be filled up with stone, this preserves usually the impressions of the teeth on the margins of the peristome.

As the anterior portion of the shells is often much compressed, leaving internally a very small space, this prolongation is in the greater number of cases even not filled with the rock mass at all, or if it has been, it breaks with the greatest ease, without leaving any peculiar marks of its previous existence. This case may be seen on *Cyp. Newboldi*, or *Kayei*, on Pl. IV, and therefore it is, tha such casts are usually much shorter than the original shell has been. All these difficulties are not seriously felt in determining neogene species, on account of the softer materials, in which they generally occur, but they have to be accounted for in the eocene, and great care must be taken in the determination of cretaceous species, for which reason alone we have specified them here.

The species which belong to this sub-family have been and are in general up to the present time described under the single generic name of *Cypræa*. Gray has after several repeated attempts at last succeeded in grouping the principal characters of the numerous species, and he divides the CYPRÆINÆ accordingly into several genera, some of which he takes as co-ordinate, others as sub-ordinate. The following genera, quoted by H. and A. Adams, are proposed; *Aricia*, *Luponia*, *Cypræa*, *Cypræovula*, *Trivia*, *Pustularia*, *Epona*. *Naria* appears doubtful, but there seems to be rather a necessity of one or two generic separations among the small and smooth species, which are partly referred to *Cypræa*, partly to *Luponia* and *Trivia*. Included in this sub-family ought to be, we believe, *Erato*, Risso, and *Pseudocassis*, Pict. et Camp., and excluded, *Marginella*.

The most apparent characters of the different genera are as follows:—

1. *Aricia* are pear-shaped shells, dorsally and posteriorly gibbose, and flattened below; in form they are most closely related to *Calpurnus* of the OVULINÆ; *Aricia moneta* is the best known shell of this type.

2. *Luponia* are globose, oviform and pear-shaped shells, below with convex margins of the aperture; the best known shell of this type is *L. tigris*.

3. *Cypræa* in the stricter sense includes the cylindrical forms with usually a thinner shell and conspicuous spire, of which *Cyp. argus* and *testudinaria* may serve as the best examples.

Connected with the difference in form of these three generic groups, there is always some kind of alteration in the dentition of the aperture, and it is carefully recorded by Gray. Several of the smaller specimens, partly distributed under *Luponia* and *Cypræa*, partly referred to *Trivia*, offer, as we have already noticed, some difficulty in being entered among these genera, and they will no doubt receive due attention.

4. *Cypræovula* is distinguished by its transversal striation, which replaces on the outer lip the dentition, and forms thus a passage to the next genus. The *Cyp. Capensis* is at present often met with in the collections, and there are several tertiary species known, which exhibit the characters of this genus very well.

5. *Trivia* is characterised by its spiral (usually called transversal) striation, being secreted from the mantle and replacing the dentition on the margins of the aperture, where these striæ become often somewhat changed in their form and tooth-like. Morphologically speaking, the striæ in *Trivia*, and the marginal teeth of the aperture in other genera of CYPRÆINÆ are identical. The two sub-genera *Pustularia* and *Epona*, as quoted by H. and A. Adams (loc. cit. p. 269) include rather characteristic forms, and will, we think, form good generic distinctions; namely,

6. Species, which are commonly somewhat depressed, and tuberculated or corrugated on the back, are assigned to *Pustularia*.

7. The shells of *Epona* are globose, mostly smooth, and with both anterior and posterior extremities much prolonged and contracted.

8. The genus *Erato* will be noticed in more detail hereafter.

9. *Pseudocassis* was established in 1863* by Messrs. Pictet and Campiche for a single cretaceous species, *Pseudocassis helveticus*. The specimens examined were only casts without any trace of shell or enamel-coating. The authors state, that there is no trace of teeth, or of any rugosity on either of the margins of the aperture. In my 'Revision of the Gastropoda of the Gosau-formation,'† I have, doubtfully, referred to this genus the *Ovula striata* of Zekeli, and at the same time, I have drawn attention to some indistinct crenulation on the outerlip of this species. So far as I can remember, there is nothing more to be noticed regarding the doubtful *Pseudocassis striata*, than I have already mentioned (loc. cit.) and for a decision on this point better materials must be obtained. It is, however, not impossible, that my suspicion (loc. cit. p. 63) of its being a *Cypræa* may be proved correct. The specimen figured by Zekeli has evidently the enamel surface wanting, and consequently the spire exposed: it is certainly not an *Ovula*, and, in any case, it belongs to the CYPRÆINÆ. Having recently had much occasion to observe closely the state in which fossil *Cyprææ* occur, I confess I am rather anxious to see, what results will be derived from an examination of the typical species of *Pseudocassis*, when it is met with complete with the shell preserved. A case in point happened to me lately. I had the description of the *Cypræa Kayei*, as a *Pseudocassis*, based upon the specimens figured on Pl. IV, Figs. 8—10, ready for more than a month: when, fortunately enough I found afterwards among our materials two other specimens, of one of which the representation is given, Fig. 7, and this, having had the shell partly preserved and being prepared with the greatest possible care, decided the point exactly in the contrary way. On a specimen of *Ps. helveticus*, very kindly presented to the Museum of the Geological Survey of India by Prof. Pictet, I cannot but persuade myself, that some impressions along the outer peristome have been originated by

* Paléontologie Suisse. 3me Ser. 2. pt. p. 361.

† Sitzungsb. Akad. Wien. Bd. LII., 1865.

some kind of denticles on the outer lip of the shell surface. So much as we know at the present of *Pseudocassis* from the details given by Pictet and Campiche, this genus differs from the other *Cyprææ* in not having any dentition or granulation on either lip of the aperture. The general form of the shell, the surface of which appears to have been smooth, agrees perfectly with the other CYPRÆINÆ and we can from this only conclude, that the genus (even if it remains defined as it is at present), must be placed in this sub-family. We have nothing from South India to add to it.

VII. CYPRÆA, Linné, (*sensu* Lamarcki).

As we have already briefly noticed the principal distinctions of the different sections or genera of the CYPRÆINÆ we would now only remark that, on account of the incompleteness of most of our specimens, we retain for the species under consideration the term *Cypræa* in its older sense, and give in addition (in parenthesis) the nearest newer determinations. Several of these names may require alteration, when more complete specimens are procured.

The *Cyprææ* live generally among rocks and on coral reefs, feeding chiefly on Anthozoa and other small animals. And there is every reason for believing, that they observed the same habits of living formerly. In the fossil state they are met with, either in sandstones or sandy beds, where they have been drifted, or in limestone banks with corals; very rarely are they found in clays, which generally have resulted from deposits in deeper waters. From European seas they appear to have mostly disappeared, although there is ample evidence, that they were formerly pretty numerous in the Vienna, Paris, and other, districts or basins.

Including the latest additions, there are about 170 living species of *Cypræa* now known; but this number must be a little reduced, because several among the smaller species (as *C. asellus, hirundo* &c., &c.) are more or less based solely upon variations in colour, which do not appear to be constant or specific. Hörnes is of opinion, * that the number of tertiary species does not exceed 44, of which 27 occur in the neogene and 17 in the eocene strata. Deshayes describes† 12 species from the Parisian basin alone. With a few recent additions from England, America and Australia, there will be at the least 55 tertiary species known, the majority of which are solely European. Up to the present time, we know very little of the *Cyprææ* from the tertiary deposits of the East. Several species occur in India (Sind, &c., and Burmah), but there has yet been no critical examination of these, or of their specific distinctions (if any) from species now living. And looking to the probable extension of tertiary seas from Persia, all through Central Asia into Japan, what a variety of forms may have existed over this wide range! Ascending from the eocene into the neogene period we may say, that the number of CYPRÆINÆ increases 50 per cent.

After many contradictions of D'Orbigny's assertions, that *Cypræa* did not occur in cretaceous rocks, it has at last been shown, that they are more numerous

* Foss. Moll. Wien, 1856; p. 61.

† Anim. sans vertebres &c., Tom. III, p. 557 &c.,

than had been suspected even a very short time since. At present (1866) four species are known from Europe, and two from America; to these we add from Southern India five new species, and one identical with an European species. This increases the total number of cretaceous *Cyprææ* to *eleven*. Including *Erato* (which is also found represented in Sth. India) and the *Pseudocassis helveticus*, the number of tolerably well-determined cretaceous CYPRÆINÆ will rise to thirteen. The East contributes about one-half to this number, from which it would appear, that even during the secondary epoch, the Eastern seas were probably warmer, and the CYPRÆINÆ consequently more numerous, than in the Western seas. The relative number seems to increase, as we proceed from America to the East, as it did also in the Tertiary times, and as it does very remarkably at the present time also.

The European species are the *Cypræa Kayei* (*Globiconcha ovula*, D'Orbigny); *Cypræa ovula*, Coquand (*non*-Lamarck) from France; *Cypræa rostrata*, Zekeli, and *Cyp. involuta*, Zekeli, sp. (*Marginella involuta*. Zek.; *Ovula involuta*, Pict. et Camp.)* from the Gosau deposits of the North-Eastern Alps;† and *Cypræa Deshayesi*, Binkhorst (*non* idem Gray) from the white chalk of Limbourg.‡ With regard to the earliest known cretaceous species, *Cypræa bullaria* and *C. spirata*, Schlotheim, we know nothing certain as yet. The species (probably identical) are not *Ovulæ*, but most probably true *Cyprææ*, and if, as Geinitz supposes, the former be identical with *Strombus ventricosus*, Reuss, it is possibly the same as the *Cyp. ovula* of D'Orbigny, or our *Cyp. Kayei*, Forbes. Gabb described two species from N. America, *Cyp. Mortoni* (Jour. Acad. Phil. 2 Ser. IV. p. 391, Pl. 68, Fig. 8), and *Cypræa Bayerquei* (Palæont. of California, 1864, I. p. 129), both of which are only imperfect casts and apparently very rare; but they belong to *Cypræa*.§

The South Indian species are *Cypræa ficulina* (an *Aricia*); *Cyp. Newboldi*, (a *Luponia*); *Cyp. Cunliffei* and *pilulosa* (belonging probably to *Luponia*); *Cyp. anomala* (probably *Epona*) and *Cyp. Kayei* (probably a true *Cypræa* in Gray's sense).

* Vide Revision der Gosau Gastropoden, Sitz. d. Akad. Wien, 1865, Bd. LII, p. 64.

† *The Ovula striata*, Zek. *(Pseudocassis ?)* from the same deposits remaining doubtful.

‡ It is to be regretted, that in the splendid monograph of the Gastropoda and Cephalopoda of the Maestricht beds, the specific names, used for new species, were not examined with a little more critical care. They often refer to long and well-known species, as I have already had occasion to notice (*Ammonites Ootacodensis=colligatus*, &c., &c).

§ It would probably be worth while to draw attention here to the *Actæonella involuta*, Coquand (Paleont. Constantine 1862, Pl. VI. f. 2) from the cretaceous rocks of North Africa. It appears to be more probably a species of the CYPRÆIDÆ than anything else, but as it is only known from a cast, no decided opinion can be formed. It could, perhaps, be a *Cyphoma* of the sub-family OVULINÆ. If there are any folds on the columella, it could possibly belong to the neighbourhood of *Volvulina* (*Actæonella lævis and crassa*), but it cannot remain under *Actæonella*, in the sense in which that genus has any claim to be retained.

1. Cypræa (Aricia) ficulina, *Stoliczka*. Pl. IV, Figs. 11 and 12.

Cyp. testa pyriformi: anticê attenuata, supra globosa, spira brevi et acuminata, infra applanata, lævigata, striis incrementi nonnullis spiralibus, partim obsoletis, rugosa; labro expanso inflexo, infra applanato, ad margînem interiorem multidentato: dentibus pliciformibus; apertura posteriorem terminationem versus sensim angustiore; labio calloso dentatoque.

Shell globose above and flattened below, pear-shaped, being highest above the centre, exposing a short pointed spire and becoming gradually narrower towards the anterior extremity. The surface exhibits striæ of growth of unequal strength, and some spiral (as regards the axis of the shell transversal) and distant striæ are seen near the peripherical margin of the outer lip. The latter is below nearly quite flat, and has inside a large number of strong elongated teeth; the inner lip is callose and, so far as can be observed on a specimen from Kullygoody, provided with similarly elongated teeth. The aperture is widest anteriorly, becoming gradually narrower towards the upper or posterior portion of the shell. On the larger specimen, figured (Fig. 12) on Pl. II., the enamel coating is only very partially preserved and it is possible that the spire is much more covered than is seen in our figure, when this enamel is perfect. The partial spiral striation is visible only on places where the enamel has been removed, and does not in so far appear to be characteristic. The largest specimen in our collection from the sand beds west of Kullygoody measures 68mm. in columellar height, and 50 mm. in width.

This species appears to be a good example of Gray's genus *Aricia*, but several points have to be settled when a perfect specimen has been procured.

Localities.—Alundanapooram and W. of Kullygoody; only three specimens are as yet known.

Formation.—Trichinopoly group.

2. Cypræa (Luponia) pilulosa, *Stoliczka*. Pl. IV, Fig. 5.

Cyp. testa ovata, antice atque postice sub-rotundata, lævigata, dorso valide inflato, gibboso, lateraliter subcompresso, anfractibus occultis; apertura lineari, antice paululum expansa atque ad extremitates effusa, prope recta; labro labioque denticulatis, primo ad peripheriam exteriorem angulatim inflexo.

Shell ovate, gibbose, laterally somewhat compressed and with roundish extremities, being slightly produced and notched; surface smooth, polished; the whorls perfectly concealed. The aperture is nearly straight, narrow, widening anteriorly, where the margins on both sides become thinner and sharper. The outer lip is somewhat extended, rapidly and angularly inflexed, finely denticulated on its entire length: the dentition on the inner lip being only partially visible in our specimens.

The lateral compression, combined with the gibbose form and the extension of the outer lip, characterizes this species very well. The *Cypræa involuta* (*Marginella* id. Zek., vide Revision der Gosau-Gastropoden, Sitzungsb. d. Akad. Wien. 1865,

Vol. LII, p. 64,) from the Gosau deposits of the Eastern Alps is, no doubt, the nearest ally to our Indian form, and, so far as I know the single specimen of the former, it differs by being anteriorly slender and more produced. Better materials, when procured on both sides, will make a closer comparison of these two forms unavoidable.

Locality.—Near Moraviatoor in Trichinopoly district; only two specimens are as yet known.

Formation.—Ootatoor group.

3. Cypræa (Luponia) Newboldi, *Forbes*. Pl. IV, Figs. 2 and 3.

1846. *Cypræa Newboldi*, Forbes, Trans. Geol. Soc., Lond., VII, p. 134, Pl. XII, Fig. 21.
1847. *Ovula incerta*, D'Orbigny, Voy. Astrolabe et Zélée, Paléont, Pl. IV, Figs. 7 and 8.
1850. „ „ D'Orbigny, Prod. II, p. 225.
1861. „ „ Gabb. in Proc. Amer. Phil. Soc., Vol. VIII, p. 121.
1864. „ „ Pictet. Mat. p. l. Pal. Suisse, Foss. Ste. Croix, 3me. ser. 2me. pt., p. 687.

Cyp. testa pyriformi, globosa, postice subobtusa, antice breviter attenuata, vix emarginata, lævi, polita, anfractibus occultis; apertura subangusta, antice dilatata, utrinque denticulata; labro inflexo, crasso, rotundato, postice extenso, antice intus insinuato, tenuissimo; labio calloso, antice sinuato atque plica elevata terminante, lateraliter compresso et acuto.

The shell is distinguished by its strong globosity, being anteriorly not much produced. The whorls are perfectly concealed and the place of the spire is indicated by a slight impression only; the surface is smooth and polished. The aperture is slightly curved, narrow above and nearly of double the width near the anterior extremity, where it is slightly notched, while the posterior channel turns quite upwards towards the dorsal convexity, exactly as in living species of *Luponia*. The outer lip is considerably thickened, posteriorly somewhat expanded, inflexed in its entire length and internally denticulated; near the anterior canal, where the aperture widens, the outer lip and equally the inner are much thinner, laterally compressed and forming more or less sharp ridges. The dentition of the inner lip is somewhat stronger near the anterior termination than in the middle and posteriorly; at the anterior canal the lip terminates with a strong fold, which can be traced all the way inside along the base of the spire; the next tooth is also somewhat longer, and both these are separated by a deeper insinuation from the other teeth. These characters also quite agree with those of living *Cypræa*. Gray regarded the inner fold along the anterior canal of greater importance than seems necessary, and established his sub-genus *Naria*, which, if based upon that peculiarity alone, must again be abandoned.

Specimens which are devoid of the shell-surface are more globular, because the anterior portion, being very thin and consisting nearly all of shell, is lost in the cast. We have figured (Pl. IV, Fig. 3) one of those casts, which also exhibits the impressions of the marginal dentition in the aperture very clearly. A similar

specimen, or, at least one with obliterate and partly destroyed shell-surface, appears to have been figured by D'Orbigny as *Ovula incerta* (loc. cit.). It is remarkable with what firmness this great French naturalist insisted upon the idea, that there are no cretaceous *Cypræa*. It seems as if he had not given in the above figure the ventral view, because it appeared to him to resemble too much a true *Cypræa*, which doubt he attempted to express in the name *incerta*. The covering of the ventral side with rock probably made its exposure impossible, and so left him in doubt.

Localities.—Kullygoody and near Andoor in Trichinopoly district; several specimens were examined.

Formation.—Trichinopoly group.

4. Cypræa (Luponia) Cunliffei, *Forbes*. Pl. IV, Fig. 4.

1846. *Cypræa Cunliffei*, Forbes, Trans. Geol. Soc., Lond., VII, p. 134, Pl. XII, Fig. 22.
1850. *Ovula antiquata*, D'Orbigny, Prod. II, p. 225, in parte.
Idem Gabb, Pictet, etc.

Cyp. testa elongate ovata, cylindracea, lævigata, utrinque emarginata; anfractibus occultis, spira in superficie impressione lævi notata; apertura angustissima, antice dilatata, dentata; labro prope recto, postice attenuato, antice insinuato atque acuto; labio plicose-dentato.

This species differs from the former, the *Cypræa Newboldi*, by its more slender and cylindrical form, and comparatively much narrower aperture. The surface is in our specimen smooth, exhibiting occasionally striæ of growth. The spiral (transversal) striation referred to by Professor Forbes is not to be observed in any of our specimens. If this striation is actually present on the enameled surface of the shell, the species will be probably better referred to *Trivia*, Gray, belonging to the sub-genus *Pustularia*. With this the somewhat more produced anterior and posterior extremities and the dense, fold-like, dentition of the inner lip are rather in conformity, which characters sufficiently justify the separation of this form from *Cypræa Newboldi*. The anterior canal is also more distinctly emarginated and the posterior shorter, than in the latter species. Forbes' figure represents a comparatively somewhat shorter specimen on account of its being either a cast, or, at least, partially devoid of the enamel coating; otherwise the dentition must have been visible.

Locality.—Near Veraghoor in Trichinopoly district; three specimens were examined.

Formation.—Arrialoor group.

5. Cypræa (? Luponia or Epona) anomala, *Stoliczka*. Pl. IV, Fig. 6.

Cyp. testa inflata, ovato-globosa, lævigata, polita, sinistrorsa, extremitate anteriori abrupte contracta, emarginata; apertura angusta, lente S-formi curvata; marginibus utrinque dense striato-dentatis; labro rotundato, antice paulum applanato.

The shell of this species is remarkably globular, being abruptly contracted at both ends. The anterior extremity is short, deeply notched, and somewhat bent back, or upwards. The posterior extremity is unfortunately devoid of the shell-surface on our specimen; it appears to have been, however, similarly formed to the anterior; the spire was perfectly concealed. So far as we are aware, this is a singular unique specimen of a *sinistrorse Cypræa;* the surface of its shell appears to be polished and smooth. The ventral portion of the shell is convex, as in Gray's sub-genus *Luponia*. The aperture is equally narrow along its entire extension, being slightly curved anteriorly towards the spiral side and denticulated on either margin. The teeth appear to be equal in number on both margins, and they are all equally thick, resembling more elongated striæ. Those on the inner lip do not reach far inside, while those of the outer margin extend internally, so far as this is inflexed. On the anterior extremity the portions of the lips are somewhat flattened and the teeth much shorter and smaller. From this striated denticulation of the margins of the aperture, combined with the entire form of the shell, this species will be probably more correctly referred to *Epona*, a sub-genus of *Trivia*, Gray; better specimens are, however, required for such a step.

Locality.—Near Vylapaudy in the Trichinopoly district the single figured specimen was found.

Formation.—Arrialoor group.

6. Cypræa Kayei, *Forbes*. Pl. IV, Figs. 7—10.

1842. *Globiconcha ovula*, D'Orbigny, Pal. franç. ter. crét. II, p. 145, Pl. 170, Fig. 3.
1846. *Cypræa Kayei*, Forbes, Trans. Geol. Soc. of Lond., VII, p. 133, Pl. XII, Fig. 20
1850. *Globiconcha ovula* and *Ovula Kayei*, D'Orbigny, Prod. II, pp. 220 and 225.
1853. *Cypræa ovula*, (D'Orb. sp.) Coquand, Journ. de Conchyl., p. 439, Pl. 14, Fig. 1. (non. id. Lamck.) *idem* Gabb in "Synopsis" of cret. foss.; Pictet in Pal. Suisse, etc.

Cyp. testa convoluta, elongate-ovata, cylindracea, lævigata, spira anfractibus circiter quinis conspicuis composita, plus minusve elevata; apertura angustissima, antice expansa, emarginata; labro crasso, rotundate-inflexo, intus denticulato, antice multo tenuiore, subacuto; labio calloso, lamellam crenulatam dentatamque formante.

Not without repeated consideration do we venture to identify our Indian fossil with the long-known European species, an imperfect cast of which was first described by D'Orbigny as *Globiconcha ovula*, and which afterwards has been proved by Coquand to be a true *Cypræa*. A full description is given by Coquand (loc. cit.), and we shall restrict our remarks merely to some peculiarities of the forms occurring in South India.

All our specimens are casts devoid of the shell, except one specimen (Fig. 7), which has the inner lip partially preserved. The callosity forms a thickened lamella, which is provided with numerous short teeth, disappearing rapidly towards the interior, so as to leave scarcely a trace of dentition, when broken away very close at the margin. A similar form of the teeth on the margins of the aperture may be seen in the recent *Cypræa testudinaria*. The anterior portion of the shell is considerably narrowed, the margins being so much compressed, that there is a very small space left internally to be filled with the rock. On the cast this lamellar anterior extremity, as observed in Coquand's figure, generally breaks away, but traces of it are visible on our specimens from South India. The posterior termination of the outer lip shows a bending somewhat upwards, and indicates a similar form of the posterior canal. The comparison of our figures of four different specimens will show, however, that the elevation of the spire increases with the size of the specimen, none of which are as broad as Professor Forbes' figure of *Cypræa Kayei*. From Forbes' description of faint lines of growth it appears, that the specimen had the shell partly preserved, and must have been, therefore, broader; but the enamel surface was certainly either not developed or wanting, otherwise the teeth of the aperture would have been visible; and equally the anterior extremity could not have been perfect, otherwise the margins were not so united as the figure represents them.

This species seems to be a true *Cypræa* in Gray's restricted sense of the genus. It appears impossible to give any strictly specific distinction between the South Indian and the European form, and we can at present only believe in their identity; we retain Forbes' name, because that of *Cypræa ovula* has been by Lamarck used for a living, species.

When we compare Reuss' figure of *Strombus ventricosus* (*vide* Versteinerungen d. Böhm. Kreide, 1845, Pt. I, p. 46, Pl. 9, Fig. 11) with that of Coquand, we find the form of both to be very nearly the same. The anterior extremity of the former is broken away, and the bending of the posterior termination of the outer lip indicates a posterior canal. The occurrence of the species in *Hippuritic* limestone agrees very well with the mode of living of *Cypræa*. Geinitz (Quadersandst, p. 138) identifies the *Strombus ventricosus* of Reuss with *Cypræa bullaria*, Schloth. from Faxœ. In comparing Sowerby's figure (Trans. Geol. Soc., Lond., V., Pl. 18, Figs. 1—3) of the latter species with our Figs. 7 and 8, it may be observed, that they equally differ very little in form, as the spire in small specimens is scarcely elevated at all. We have at present no other object than to refer to those similarities which are suggestions merely; but we do not hesitate to state, that there would be little reason for surprise, if all these forms were shown to be identical.

Localities.—Near Andoor and S. of Serdamungalum in the Trichinopoly and near Arrialoor in the Arrialoor-group; the species is rare, only five specimens having been as yet found. The two first-named localities are close to the boundary of both groups, and they also may probably belong to the latter.

Formations.—Trichinopoly and Arrialoor groups. In France *Cypræa (Ovula) Kayei* is quoted from D'Orbigny's Senonien, or the White Chalk.

VIII. ERATO, *Risso.* 1826.

Er. testa ovali, convoluta: spira conspicua, brevi; ultimo anfractu plus minusve pyriformi, maximo; apertura angusta, antice atque postice emarginata, seu subcanaliculata, labro intus denticulato, labio antice plicose-dentato, postice edentulo.

H. and A. Adams, Chenu, and others separate the genus *Erato* from *Cypræa* altogether, and place it with *Marginella*, &c., in the family *Marginellidæ*. Even Reeve in his latest monograph of this genus (Conch. Icon., 1865) says:—"*Erato* is a form of *Marginella*, in which the columella, like the lip, is not sculptured until it arrives at maturity." This is certainly in conformity with *Cypræa*, and not with *Marginella*, with which also the enamel covering of the shell does not agree. Hörnes (Foss. Moll. Wien. I, p. 77) pointed out very correctly the differences between the shells of *Erato* and *Marginella*. The former, he says, does not possess any actual plicæ on the columellar margin (as *Marginella* very distinctly does), but only somewhat elongated teeth, for which the term 'obsolete plicata' has been used. Hörnes further drew attention to the great similarity of the shell of *Erato* with that of a young, or rather not full-grown, *Cypræa*; indeed, in comparing, for instance, specimens of *Cypræa asellus* or any allied species,—before they are quite full grown and when the enamel covering is not yet very thickly secreted, the spire somewhat conspicuous, and the teeth of the inner lip not much developed,—the similarity of such specimens to shells of *Erato* is so striking, that nobody would hesitate to regard *Erato* merely as a form of *Cypræa*. It appears as if the animals of the former had been by some cause or other stopped in the progressive development of their shell, while *Cypræa* made a step farther and secreted so much enamel as to cover the entire spire, by which character alone some species of *Luponia* differ from *Erato*.

In my revision of the Gastropoda of the Alpine Gosau formation I have observed, that the *Cyprææ* of the older formations (not beyond the cretaceous) show very often an elevated spire, and that the margins of their aperture have often a finer dentition than in living species. Overlooking the deficient state of preservation, which makes the true characters of *Cypræa* often rather obliterate, the elevation of the spire in several eocene and cretaceous species is certainly not always accidental, and seems actually to indicate a certain state of imperfection in the development. I do not mean to convey by this remark, that the cretaceous or eocene species with conspicuous spire ought to be referred to *Erato* on account of this single character alone; but when the surface of the shell, as far as can be distinctly observed, appears quite perfect, not enveloped by the callosity of the last volution, and when the middle and posterior portions of the inner lip do not show a trace of dentition, as in the species we are about to describe here, there seems to be a necessity to refer the same to *Erato* rather than to *Cypræa*. The single objection which could be

raised in our case of the Indian species is, that it has the posterior canal more strongly marked than is usually observed in the living species of *Erato*.

As regards the classification of *Erato* next to *Cypræa*, we need hardly remark further, that the animals of both are very similar, as was long since shown by the first detailed descriptions of Philippi. Gray (Guide to Moll. Brit. Mus., 1857, p. 74,) says, "this genus (referring to *Erato*) differs from *Marginella* in having a rostrum or proboscis."

L. Reeve in his monograph of *Erato* (Conch. Icon., 1865) describes 18 species, of which he states that their geographical distribution is quite different from that of *Marginella*. Six species of tertiary fossil *Erato* are recorded, including the three lately noticed by Deshayes from the Paris basin (Tom III, p. 556), and of these six species *Erato lævis* occurs also recent in the Mediterranean Sea. From the cretaceous rocks the following species is, we believe, the only one as yet described:—

1. Erato Veraghoorensis, *Stoliczka*. Pl. IV, Figs. 13 and 14.

Erato testa pyriformi, inflata, antice attenuata, in superficie lævigata, spira brevi, acuminata; apertura angusta, S.-formi, ad extremitates effusa; labro rotundate inflexo, postice expanso, interne crenulate-denticulato; labio antico planato, et ad marginem interiorem dentato.

The young shell is elongated, ovate; the adult, by becoming posteriorly more inflated, globose, and being at the same time attenuated anteriorly acquires a pear-shaped form: the surface is smooth and polished. The spire consists of five or six volutions, and is so little prominent, that it measures only about one-seventh or one-eighth of the total length of the axis. The outer lip is thickened, at the posterior extremity expanded, ear-shaped, along its entire length inflexed, and on the interior margin densely and finely denticulated. The inner lip is on the columellar place flattened, bearing on the lower or inner margin a few small roundish teeth. The aperture is narrow, slightly S-form, canaliculated on both ends.

Besides the very characteristic form and the expansion of the posterior portion of the outer lip, the dentition of this species is remarkable, the teeth not being in any way elongated, as usually in the genus *Cypræa*, but more roundish, isolated, placed exactly on the sharp margins of the outer and of the anterior portion of the inner lip. On the other hand the posterior canal is equally peculiar, being turned perfectly upwards, bounded by a thickening of both lips, as usually seen in *Luponia*, but rarely in *Erato*.

Locality.—Near Veraghoor, in Trichinopoly district; four specimens have been examined, but none of them has the anterior canal perfectly preserved.

Formation.—Arrialoor group.

III. *Family—OLIVIDÆ.*

The *Olividæ*, represented by the well-known genera *Oliva* and *Ancillaria*, are, as regards structure and form of shells, most nearly allied to the *Cypræidæ*, and form (through the sub-family *harpinæ* and the family *Dolidæ*) a passage to the *Cassididæ*. The animals of the *Olividæ* are to some extent like young *Cypræidæ*, inasmuch as they have in front a kind of mantle-lobe, which also resembles that of the animals of the *Tornatellidæ* and *Bullidæ*. In the *Cypræidæ* this mantle-lobe disappears totally, or very nearly so, while in the *Olividæ* it developes itself rather more strongly with advancing age. The dentition forms a marked difference in these two families.

The existence of the anterior and posterior filamentose process and the enclosure of the latter in a separate groove at the suture admits of a convenient separation of the family into two sub-families, *olivinæ* and *ancillarinæ*. Gray includes in this family the genus *Harpa* as a sub-family also, *harpalinæ* or rather *harpinæ*, and, as the animals of *Harpa* do not seem to differ essentially, this classification appears acceptable.

The fossil species of the *Olividæ* do not date earlier than the cretaceous period. Of the *olivinæ* three and of the *ancillarinæ* two species are known from these deposits.

a. Sub-family—OLIVINÆ.

The first species of the *olivinæ* was described by Professor Forbes from the South Indian cretaceous rocks as *Oliva vetusta* (Trans. Geol. Soc., Lond., VII., p. 134, Pl. 12, Fig. 23). Mr. H. Blanford (Mem. Geol. Surv., IV., p. 141,) mentions that an *Oliva* occurs in the Arrialoor beds at Ninnyoor; but we have not seen a trace of this shell, and cannot therefore pronounce an opinion on it. Forbes' species appears to belong to *Olivella*, but it may be premature to make such changes, before well-preserved specimens have been examined.

The second species is *Oliva prisca*, Binkhorst (Monog. Gastr. et Ceph. craie sup. de Limbourg, 1861, p. 71, Pl. V, A 2, Fig. 14) from upper cretaceous beds; the species is based upon an imperfect cast, and appears rather doubtful; it could quite as well be a cast of a *Cypræa* or *Erato*.

The third species, *Olivella Mathewsonii*, was lately noticed by W. Gabb from the cretaceous deposits of California (Pal. of Calif., I, 1864, p. 100, Pl. 18, Fig. 53).

b. Sub-family—ANCILLARINÆ.

The two as yet known species belonging to this sub-family are *An. cretacea*, Müller (Petref. d. Aachner Kreide, 1851, p. 79, Pl. VI, Fig. 23) and *An. elongata*, Gabb. (Pal. Calif. I, 1864, p. 100, Pl. 18, Fig. 54).

c. Sub-family—HARPINÆ.

No cretaceous fossils, belonging to this sub-family, have as yet been reported. There are about five tertiary and fifteen recent species of *Harpa* known.

IV. *Family,—DOLIIDÆ.*

(*Vide* H. and A. Adams, Genera, p. 195; Gray's Guide, 1857, p. 40.)

There are usually only two genera distinguished—

1. *Dolium*, Lamk. 1801 (? Browne).
2. *Malea*, Valenc. 1833 (*Cadium* apud Adams).

The second genus forms through its thickened outer-and inner-lips a transition to the *Cassididæ*. The *Doliidæ* are almost uniformly distributed, but sparingly represented in the temperate and tropical waters; there are at present only 22 recent species known; the number of the tertiary fossil species does not much exceed half that of the recent ones, and from cretaceous beds there has been only one species described by Sowerby (Min. Conch., Vol. V. p. 34., Pl. 426 and 427) as *Dolium nodosum* from the lower chalk of Clayton in Sussex. D'Orbigny transferred the species to *Strombus*, as *St. nodulosus*—and Pictet and Campiche (Mat. p. l. Pal. Suisse, 3me. Ser. Foss. Ste. Croix., p. 583) are of opinion, that it is most probably a *Pterocera*, which from its resemblance to *Pterocera incerta*, D'Orb. certainly appears very likely to be the case. Unless, however, this supposition is confirmed by new discoveries, any such alterations can only be provisional.

V. *Family,—CASSIDIDÆ.*

Shell ventricose, spire short, the last volution enveloping the previous to a great extent; aperture elongated, generally narrow; margins more or less thickened and toothed or plaited; anterior canal generally distinct, short and re-curved upwards; posterior canal seldom distinct, usually only indicated by a depression on the margins. The surface of the shell is generally richly ornamented with spiral sulci or transverse, often interrupted, ribs.

The animals are not less characteristic than the shells. They have mostly a long neck with not very distinct head, long proboscis and tentacles with the eyes on the outer side, sessile on well developed short bulgings. As regards the dentition they are Tænioglossa *(Gray)*. The foot is generally large and dilated, resembling that of *Ranella* and *Tritonium*, the former genus being *(in parte)* placed by Gray in this family. The animals of *Ranella* and some genera of the *Cassididæ* are in fact nearly identical, but the shells exhibit some very noteworthy differences, which do not seem to be in favour of Gray's classification of *Ranella*. It is indeed difficult to assign a proper transitional place to this family. The animals appear to form directly a passage from the *Cypræidæ*, *Olividæ* and *Harpidæ* to the *Tritonidæ*, *Buccinidæ* and *Muricidæ*, while the shells of several forms of the *Cassididæ* are undoubtedly most nearly allied to the *Pleurotomidæ*, for which reason we have placed them here.

Although the *Cassididæ* by no means belong to the category of rare shells, there still exists so much controversy as regards the number and names of the

genera to be admitted, that it appears best to treat the fossil forms under the more general terms *Cassis*, *Cassidaria (sensu Lamarcki)* and *Oniscia*, Sowerby. This course is also strongly advocated by Deshayes in his last contribution to the Paris fossils (Tom. III, pp. 471, &c.), and it may at present do well enough for the fossil forms; although there can be no question, that some system of classification, of the recent species of *Cassis* and *Cassidaria*, as proposed by H. and A. Adams, Gray and others, must be adopted, as otherwise it would certainly be impossible to give a strict definition of the group. Chenu, Gray and others add *Pachybatron*, Gask. and *Cythara*, Shuhm. to this family; the latter genus seems to be, however, more properly placed in the family *Pleurotomidæ*, as will be found stated more fully hereafter.

The number of fossil species of *Cassididæ* is not very large in the tertiary deposits (see Deshayes, Tom. III, pp. 474 and 482), and in the secondary, it is very limited. The *Cassis corallina*, Quenstedt, from the Nattheim coral-rag having been proved by Dr. Rolle to belong to the family of *Columbellidæ* and separated as a distinct genus under the name of *Columbellaria* (see the family *Columbellidæ*), the earliest true representatives of the *Cassididæ* are met with in the cretaceous deposits. Of *Cassis* no cretaceous species has been as yet reported. Of the section *Cassidaria* three species are known, *C. cretacea*, Müller (Monog. d. Petref. d. Aachner Kreide, 1851, II pt., p. 17, Pl. III, Fig. 21); *Morio tuberculatus*, Gabb. (Pal. Calif. 1864, I. p. 104, Pl. 19, Fig. 57); and *Sconsia Alabamensis*, Gabb (Jour. Acad. Phil. 1860, IV, p. 801, Pl. 48, Fig. 13). This last named species is doubtful, but the two other appear to be true *Cassidariæ*. Of *Oniscia* we have to notice the first cretaceous species described. It has been found represented in a comparatively well preserved specimen, so as to leave little doubt as to its generic determination, and in beds attributed by Mr. H. Blanford to the highest division of the South Indian cretaceous deposits.

IX. ONISCIA, *Sowerby*, 1825.

The principal character of this genus, as distinctive from the *Cassidariæ*, lies in the granulation of the thickened inner lip. It is hardly necessary to say, that the scarcely known name of Bolten, *Morum*, cannot compete with the universally known *Oniscia*, nor do I see any particular use in distinguishing the genera (*Oniscia* and *Morum*, Gray; *Morum* and subgenus *Oniscidia*, Adams and Chenu.) The difference between *Oniscia* and *Morum*, as stated by Gray (Guide, 1857, p. 70) reduces itself respectively to a plaited or denticulated outer lip, the limit of which character varies with the age of shells of one and the same species. I can scarcely believe, that the animals could show any such essential difference as to support the necessity for two genera. The cretaceous species, which we refer to this genus, has the same form and a granulated thickened inner lip like other *Onisciæ*. The canal is produced and recurved, the outer lip reflexed and rounded with a thickened margin exteriorly as in *Oniscia* proper (according to Gray), but it is toothed internally, as in *Morum* (apud Gray).

1. Oniscia costellata, *Stoliczka*. Pl. V, Fig. 9.

On. testa ovali, antice caudata, postice apice acuta; anfractibus 6-7, *scalariformibus, ad suturam posteriorem valde constrictis, transversaliter costulatis: costulis acutis, prope rectis, circiter* 18 *in uno circuitu; apertura angustissima, lineari, labro ad peripheriam valde incrassato, interne denticulato, labio calloso, postice acuminato, elevato, dense crenulato; canali moderato, recurvo.*

Width of the last whorl : height (consd. as 1·00)	0·68
Height of aperture : total height of shell (consd. as 1·00)	0·63

Shell elongated, considerably tapering towards each end, consisting of six or seven volutions, the last of which by far exceeds the previous in size, so as to form about three-fifths of the total height of the shell. On the upper or posterior suture the whorls are much constricted, each ornamented with about 18 nearly straight and sharp transverse ribs. Of spiral striæ there are scarcely any traces perceptible, and they must have been very fine. The aperture is very narrow and oblique, forming a slight curve. The outer lip is at its margin, and especially at the outer edge, very thick, little expanded and reflected, internally in its entire length denticulated; the inner is callose, especially posteriorly near the suture, where it is considerably elevated, covering the greater part of the front or ventral side of the last whorl; it is all over finely crenulated and, in the middle of the space of the aperture, slightly insinuated. The canal is proportionally long, thin, recurved and on the termination emarginate.

The somewhat inflated form in the middle of the shell, the sharp transversal ribs, the prolonged and recurved canal, the narrowness of the aperture and the want of the insinuation on the outer lip distinguish this species without difficulty from *Cythara cretacea*, n. sp., even when the inner lip or its granulation is not well preserved.

Locality.—South of Arrialoor in Trichinopoly District, where the single figured specimen was found.

Formation.—Arrialoor group.

VI. *Family,—PLEUROTOMIDÆ.*

(Turritidæ, Adams, *non* Gray.)

The common character of the different genera usually admitted into this family, reduces itself to *fusiform shells with a posterior notch on the outer lip.*

The animals are all very similar; they have an oval and simple foot, enclosed mantle, approached subulate tentacles, with the eyes on the outer side near the base or the middle; subulate, elongated teeth etc., all characters in which they resemble the *Conidæ*. Deshayes was among the first who drew attention to the relations of *Pleurotoma* and *Conus*. The newer observations of the animals by Quoy,

Forbes and Hanley, Gray and others, support very much this view. There are in fact, especially among the fossil forms of *Pleurotoma*, species, which have such a short spire compared with the last volution, that they resemble most closely the slender and elongated species of *Conus*. The slit near the posterior termination of the outer lip is equally not unlike in both. I would recall only *Pl. mitræformis*, Kien. and *Con. stromboides*, Lam. respectively. Similarities like these and others may induce Deshayes to unite *Pleurotoma* and *Conus* into one family CONIDÆ, as proposed by Woodward. Of course this speaks for itself, since Deshayes does not much consent to a further division of the genus *Pleurotoma* in Lamarck's sense, but I believe it quite impossible to retain such a unity at present, as opposed to the late progress in conchological science. It is no doubt remarkable, that those species of *Pleurotomæ*, which are most nearly like in form to *Conus*, have the eyes near the middle of the tentacles, those with a more elongated and fusiform shell have the eyes at the base, like the FUSINÆ, and so we have an equal relation to both.

Gray, in his Guide of 1857, treats the family PLEUROTOMIDÆ, as regards the teeth of the radula, with the CONIDÆ in his sub-order TOXIFERA, and this seems to be their best place, although I would for my own part not have greater confidence in the dentition, than in the other points of relation. H. and A. Adams refer their TURRITIDÆ to the RACHIGLOSSA, next to the FUSINÆ of the family MURICIDÆ to which the true *Pleurotomæ*, as regards their form, are no doubt most closely related.

Adams, Gray and others agree in dividing the PLEUROTOMIDÆ into three sub-families, namely CLATHURELLINÆ, CLAVATULINÆ and PLEUROTOMINÆ.

a. The names CLATHURELLINÆ and *Clathurella*, Carp. respectively, have been supplied by H. and A. Adams in the corrections (Genera, Vol. II. p. 654) for the previously applied name DEFRANCINÆ, as the name *Defrancia*, Millet, 1826 (1827 ?), must be abandoned, because the same had been used in 1825 by Bronn for a genus of the Bryozoa. The genera of this sub-family are very much related to the CASSIDIDÆ, but most conchologists treat *Cythara*, Shum. in this sub-family, while others follow Gray's classification of this genus with the CASSIDÆ. We would only here draw further attention to the animal of *Cythara*, inasmuch as it has posteriorly a pointed, not a trunked, foot like most other PLEUROTOMIDÆ; otherwise there seems no reasonable ground for a separation. It is of course very desirable, that many more animals were observed and examined, and it may be then found, that several alterations are to be admitted in this sub-family. There is only one species in our Indian collection belonging to this group of shells; it will be found described as *Cythara cretacea*, n. sp.

The genus *Clavatula* is accepted by Deshayes in his last edition of the Paris fossils, III., p. 340.

b. The CLAVATULINÆ have an operculum with a latero-central nucleus.

c. The PLEUROTOMINÆ have an operculum with an apical nucleus; they are mostly elongated fusiform shells.

In this sub-family we have to mention one genus, which is represented in the cretaceous fossils of the South Indian deposits. There exist still great differences as to the defining of the different genera of the *PLEUROTOMINÆ*, as may be seen on a review of Adams's, Carpenter's, Gray's, Chenu's and others' researches. We had already occasion to state, (Sitzungsb. Akad.Wien., 1865, Vol. LII, Revision &c., p. 86) that there is no hope of arriving at any satisfactory understanding on this point, unless the very numerous fossil species are included in such a classificatory attempt. Even greatly increased anatomical researches will in this case not bring the point in question much farther.

a. *Sub-family,—CLATHURELLINÆ.*

X. CYTHARA, *Shuhmacher*, 1817.

(*Vide* Adams' Gen. I. p. 98; *Cithara**, Gray's Guide, 1857, p. 40.)

H. and A. Adams remark, that "in the slight dilatation of the mantle margin, in the short spire, and in the corrugated inner and thickened outer lips," this genus "somewhat resembles *Morum (Oniscia)* among the *CASSIDIDÆ*." Gray places *Cithara (= Cythara)* actually in the last named family, that is, next to *Oniscia* in one sub-division.

I may first remark, that I compare our fossil species only with those typical forms of *Cythara*, as *Cyth. marginelloides*, *citharella*, *stromboides* and others, but I am not prepared to say, whether all the species quoted by Adams under *Cythara* should remain within the limits of this genus. In comparing the cretaceous species here under description with *Cyth. marginelloides*, it is instantly apparent, that no reasonable ground can be given for a generic separation of the two species, inasmuch as the general form is nearly the same, the inner lip corrugated, the outer lip thickened, toothed internally, and posteriorly with an insinuation of the margin.

When we farther compare the two oldest known species of *Oniscia* and *Cythara* respectively, as here stated and figured on Plate V, we see that they agree very much in the form and structure of their shells, that the corrugation and partial granulation of the inner lip of the *Cyth. cretacea* is at least remarkably like that of *Oniscia costellata*, and that the thickenings of the outer lip with the blunt exterior edge are formed in a perfectly identical manner in both; but that the margin of the *outer lip* of the *Cythara* has *posteriorly a sinuosity*, and so still retains the principal character not only of the genus, but at the same time that of the entire family of the *PLEUROTOMIDÆ*, as I have previously remarked. It must be said, that the insinuation of the outer lip is an essential character of the *PLEUROTOMIDÆ*, as also partially of the *CONIDÆ*. A second very marked character in our cretaceous species and in most other living species of *Cythara* is the *straightness of the anterior canal*, which in all *CASSIDIDÆ* is constantly recurved or turned upwards. As the

* From *Mr. Mörch's* notes on a few of Link's genera it would appear, that *Cithara*, Klein, is the same as *Harpa*, Lam., and that there ought to be two sub-divisions established *Harpalis*, Link *(H. antiquata)*, and *Harpa* Lamk. *(H. costata)*. (Proceed. Zool. Soc. Lond, 1862, p. 227.)

result of the examination of the two oldest species of *Oniscia* and *Cythara*, I may therefore record, that while both of them show very remarkable affinities in the general growth of the shell to each other, each of them separately retains still the typical characters of its respective family. Unless, therefore, it could be proved by anatomical researches on the animal of *Cythara*, that it has very little in common with the organization of the *Pleurotomidæ* (apparently a very improbable case) and that it agrees much more with that of the other *Cassididæ*, Gray's proposed classification of this genus in the latter family cannot be accepted.

One point may be worthy of notice. Gray quotes among his distinctions between *Oniscia* and *Morum*, that the outer lip of the former is reflected and rounded (in front!), while in the latter it has a shelving outer edge. The outer lip of *Cythara* has also a shelving outer edge, while in the cretaceous species, which we describe, the outer lip is reflected, rounded in front, and with a blunt, broad outer edge. It would appear, therefore, that there exists a similar difference between the *Cyth. cretacea* and the living species of *Cythara*, as between *Oniscia* and *Morum* of Gray; but I have already stated, that this difference between *Oniscia* and *Morum* appears to me to be so much subject to variations during the age of even one and the same species, and depending so much upon the localities and modes of life of the species, that I do not think it can be fairly used as a generic distinction. The fact is, however, worthy of record, and it is possible that some further enquiries may prove to be in favour of this reported distinction, as our knowledge daily advances.

It is difficult to say anything about the fossil species of *Cythara*, although they are not wanting either in the neogene or eocene deposits; they are all described under *Pleurotoma* or *Mangelia*. A similar remark applies to the cretaceous species, although, if the *Pl. arata*, Gabb (Proc. nat. sc. Phil. for 1860, p. 198, Pl. 3, Fig. 9) does not belong to this group, I am not aware of any other, which would bear approximately the characters of the genus.

1. Cythara cretacea, *Stoliczka*. Pl. V., Fig. 10.

Cyth. testa elongate-ovata, spira brevi, acuminata, anfractibus subconvexis, 4-5, striis spiralibus atque costulis transversalibus cancellatis, ultimo spira multo longiore; canali brevi, vix curvato, antice late emarginato; apertura ovali, antice atque postice subacuta; labio calloso, ultimum anfractum infrá partim tegente, ad marginem internum papillose crenato; labro parum extenso, ad peripheriam incrassato, prope terminationem posteriorem late insinuato, intus anticeque undulate dentato.

Width of the last whorl :	total height of shell (considered as 1·00)		...	0·45
Height of aperture :	ditto	ditto	...	0·69

An elongated ovate shell, convex above and somewhat flattened below, the last whorl enveloping the previous to a great extent and occupying somewhat more than two-thirds of the total height. The convexity of the whorls is not considerable, and their surface is cancellated by spiral striæ and transversal ribbings. The

former are very numerous and nearly all of equal strength and equally distant, some very fine ones being occasionally intermingled between the others. The transverse ribs are somewhat stronger and broader, resembling periodical accumulations of striæ of growth; they are slightly flexuous on the last volutions. The aperture is oval, pointed at each end, callose internally. The outer lip is a little expanded and thickened, on the margin somewhat reflexed, rounded in front and very thick on the outer edge; internally flattened, near the posterior extremity deeply and broadly insinuated, and towards the anterior extremity provided with slight denticulations. The inner lip is callose, apparently not much enlarged and on the apertural margin provided with short papillæ, or partially granulated. The canal is short, broad, very slightly bent to the left side (in front view), and widely emarginated.

The peculiar cancellate ornamentation of the surface, the short, nearly straight and widened canal, the broad but shallow insinuation of the outer lip near the posterior termination and the thick outer edge of the same, are the chief distinctive characters of this species.

Locality.—Near Veraghoor, in Trichinopoly district; the figured specimen is as yet unique.

Formation.—Arrialoor group.

XI. PLEUROTOMA, *Lamarck*, 1799.

Pl. testa fusiformi, spira turrita; canali longo atque recto; columella lævi; labro posterius sinu emarginato.

We accept here the genus *Pleurotoma* in its restricted sense for the turreted shells with a long and straight canal and an emargination of the outer lip near the suture. The name *Turris*, substituted by Adams for *Pleurotoma*, has been very hastily introduced by American authors into palæontological literature, and with very little reason indeed. H. and A. Adams use (*loc. cit.* I., p. 87.) *Turris*, Humph., instead of *Pleurotoma*, Lamk.; on p. 351 of the same volume they quote *Turris*, Humph., not Bolten, as a synonym with *Turritella*, Lamk., and, on p. 246, they say, that they are indebted for valuable information to Dr. Gray, namely, that the *Turridæ** belong possibly to the sub-order Toxifera. If we consult Gray's Guide of 1857 on this point, we find Adams' *Turritidæ* replaced by the usual denomination *Pleurotomidæ* (p. 7) and under *Turritidæ*, and *Turris* (whose?) respectively some species treated, which the Adams refer to the *Cancellariidæ* and others. It appears that Dr. Gray has changed his mind since his communication with the authors of the "Genera." Agassiz (in his Nomenclator) quotes the name *Turris*, Humph. 1797, and does not know Bolten's name. Chenu and Gabb add to *Turris* the authority, Bolten 1798, and not Humphrey.

* *Vide* Vol. II., p. 614. H and A. Adams partly correct this misapprehension and call the family *Turridæ* and the sub-family *turrinæ*!! Has this change been introduced for the sake of avoiding a confusion with *Turris* and *Turritidæ* of Gray, or merely to correct the expressions in a grammatical point of view?

This shows, I believe, clearly enough, what reason there exists for the adoption of the name and authority of *Turris* against that of *Pleurotoma*, and for substituting this doubtful and obscure name for one which has been familiar ever since naturalists began to look at a shell with a scientific object;—so much for the names *Pleurotoma* and *Turris*.

The number of living and tertiary species of *Pleurotoma* is very great, but there are only few known, which have been described under this name from the cretaceous deposits. Excluding the very uncertain species (vide Pictet, Pal. Suiss. 3 me ser. pt. II p. 655) the following have to be noticed:—

1. *Pl. subfusiformis*, D'Orb., known from the Gosau and from South India; will be described in the following pages.

2. *Pl. fenestrata*, Zekeli, (vide Revision, etc., Sitzungsb. Akad. Wien 1865, LII, p. 87) from the Gosau deposits, belongs probably to *Clathurella*, Carp. (*Defrancia*, Millet.), but is not very certain.

3. *Pl. Heisiana*, Müller, from the cretaceous strata near Aachen, a very peculiar form, which, so far as the figure admits of a definite opinion, has to be classed with *Pl. terebralis*, Lamarck, *Pl. subterebralis*, Bell, *Pl. dimidiata*, Brocchi, and other fossil forms.

To these three European, no less than thirteen American species have to be added, *viz.*:—

4—16. *Pl. araucaria*, D'Orbigny, Prodr. II., p. 230; *Pl. arata* and *d'Orbignyana*, Gabb; *Pl. contorta*, Meek and Hayden.; *Pl. minor*, E. and Shumard, (Gabb's Synopsis, Proc. Amer. Phil. Acad. VIII, p. 145. *Turris*); *Pl.* (*Turris*) *Claytonensis*, and *varicostata*, Gabb, (Pal. of California, I. 1864, pp. 92, 93). The first three are from Chili, the other four from North America. Further *Daphnella? Eufalensis, ? lintea, ? subfilosa; Drillia distans, novemcostata, ? Tippana;* all species named by Conrad (see Gabb, Synop. *loc. cit.* pp. 104, 105), from Alabama and Mississippi.

Mesochilostoma is a doubtful genus proposed by H. Seeley in 1861 (Ann. Mag. Nat. Hist. Ser. III., Vol. VII., p. 284) for a species from the upper Greensand of Cambridge. The shell is characterized as *turreted, with a* supposed *short canal*, and *on the outer lip with a notch, which forms a keel round the middle of the whorls.* There are numbers of species known, specially of the CLAVATULINÆ, which have these characters perfectly developed. The short description of the species, *M. striata*, given by Mr. Seeley, does not add anything more to the knowledge of the genus, and it is impossible to form a clear idea of either of them.

The following species have to be excluded in addition to those quoted by Pictet and others: *Pl. heptagona*, Zekeli, quoted by Pictet, belongs to *Pl. subfusiformis*, D'Orb.—*Pl. (Turris) involuta*, Goldfuss, mentioned by Gabb in his catalogue, must be referred to the VOLUTIDÆ; and *Pl. subspinosa*, D'Orb. (ibid.) is *Borsonia spinosa*, Sow. sp. (Stoliczka, Rev. etc. Sitzungsb. Akad. Wien, 1865 Bd. LII. p. 87.) The second known species of PLEUROTOMIDÆ with plaited columella is *Cordiera microptygma* (Gabb, Pal. Calif. I. 93).

The total number of cretaceous *Pleurotomidæ*, although beside those mentioned several others will have to be excluded, would be up to the present time 17, if the American species are actually as numerous as thirteen or fourteen. I have repeatedly gone over the brief descriptions and compared the figures given by Conrad of some of the species of *Daphnella and Drillia*, and they certainly appear to me extremely doubtful. Not to say anything of the species, scarcely one of the genera appear determinable with even approximate accuracy.

1. Pleurotoma subfusiformis, *D'Orb.* Pl. VI, Figs. 1 and 2.

1831. *Pleurotoma fusiforme*, Sowerby, Trans. Geol. Soc., Lond. III, Pl. 39, Fig. 20: (non *Pl. id.* Sow. 1823, Min. Conch. IV, Pl. 387, Fig. 1.
1850. „ *subfusiformis*, D'Orbigny, Prod. II, p. 230.
1852. „ *heptagona*, Zekeli, Gasterop. d. Gosau. Abhandlg. d. Geol. Reichs-A. Wien, Vol. I, pt. 1, p. 91, Pl. 16, Fig. 8; non. *F. heptagonus*, Sow.
1853. „ „ Reuss, Sitzungsb. d. Akad. Wien, Vol. XI, p. 915.
1861. *Turris subfusiformis*, Gabb, Proc. Am. Phil. Soc. VIII, p. 145.
1864. *Pleurotoma* „ Pictet, Mat. p. l., Pal. Suisse, 3me Ser. Foss. Ste. Croix. p. 654.
1865. „ *fusiformis*, Stoliczka, Sitzungsb. Akad. Wien, Vol. LII, Rev. etc. p. 86.

Pl. testa fusiformi, perlonga; anfractibus, numerosis, parum convexis, ad medium subangulatis, supra excavatis, transversim costatis ac spiraliter striatis: costis crassis, nodulosis, supra evanescentibus, striis 4-5, *spiralibus transeuntibus ornatis; labro paululum extenso, postice prope suturam profunde sinuoso; canali longo, recto, ad terminationem paululum contorto.*

Spiral angle 30°—36°; sutural angle 7°.

Shell very long, consisting of about ten whorls, which are much contracted at the upper suture and slightly angulated near the middle. Each of them is ornamented with nine or ten short and thick transverse ribs, disappearing on the upper portion; they are crossed by four or five spiral striæ. When the surface is well preserved, it presents numerous striæ or lines of growth, which being somewhat elevated like undulating laminæ, give it rather a rough appearance. Near the suture they are strongly bent inward, and accumulate on the same generally to a thickened margin. The last whorl including the canal is about the same length as the spire. The inner lip is thin and smooth, the outer somewhat produced in the middle; the anterior termination of the canal is a little turned.

There are several very similar species known from the neogene and eocene deposits. I would notice only *Pl. Lamarki*, Bell., (Hörnes, Foss. Moll. Wien. p. 362, Pl. 39, Figs. 4—7) and *Pl. brevirostrum*, Sow. (Min. Conch. IV, Pl. 387, Fig. 2); it is scarcely possible to give any mark of distinction from the former.

This species was first collected in the Gosau by Sedgwick and Murchison on their early visit to the Alps, and was figured by Sowerby under the name *P. fusiforme* in 1831, which name has been subsequently changed by D'Orbigny. Zekeli in describing the Gastropoda of the Gosau formation, identified the shell with a totally

different species, as I have pointed out in my revision of the Gosau Gastropoda (*loc. cit.*) I have compared our Indian specimens with those from the Gosau, and I am unable to give any distinctions. The form of the shell, number of whorls, the short nodulose, transverse ribs—generally about 9, the thickened spiral striæ, as well as the undulating striæ of growth with their insinuations near the suture agree perfectly. Sowerby's figure is characteristic enough, but that of Zekeli is derived from an imperfect specimen, and has not been very correctly restored.

Localities.—Andoor, Alundanapooram, and near Olapaudy in Trichinopoly district; not common.

Formation.—Trichinopoly group, near the boundary of the Arrialoor,—to which the last named locality refers according to Blanford's map.

VII. *Family,—CONIDÆ.*

Idem, Adams, Chenu and others; Conusidæ, Gray.

As universally acknowledged, this is one of the most peculiar and interesting families of the Gastropoda. The animals are all very much alike, being laterally compressed in accordance with the narrow inner space of the whorls, with an oblong and undivided foot which is provided with an aquiferous pore on the under surface. The head is produced into a tubular veil, with a retractile proboscis and subulate teeth, placed generally in two series on a prolongation of the proboscis. The tentacles are thickened at the base, close together on the tubular veil, which surrounds the mouth; the eyes are sessile on small bulgings, generally about the middle of the outer side of the tentacles. The siphon is long, recurved, producing an emargination on the anterior extremity of the *reversed conical* shell, *the spire of which is more or less, but never very considerably elevated and pointed.*

From the great peculiarity in the dentition—Toxiglossa in Gray's sense—H. and A. Adams describe the *Conidæ* as a separate family in the higher division of Toxifera of Gray. The latter author refers to the same sub-order the *Conusidæ*, *Acusidæ* and *Pleurotomidæ* (see Guide 1857, pp. 4—7), each of which includes several genera. As regards the first and the last family (*Conidæ* and *Pleurotomidæ*), we think Gray's classification of high value; but we do not accept the *Acusidæ*,—more properly *Terebridæ*,—and shall refer to this family subsequently towards the end of the Siphonostomata, near to the *Pyramidellidæ*. We believe that the shells of the *Terebridæ* have a great relation to those of the *Pyramidellidæ* and *Cerithiidæ*, and even their animals in the form of their locomotive organ, the thick proboscis, small siphon, &c., are very closely allied to *Vertagus* and others. Geological considerations also are more in favour of this latter classification. Deshayes places the *Pleurotomidæ* and *Conidæ* in one family under the last name. (Foss. de Paris, III, 337.)

The *Conidæ* have been up to the present, and are still generally described under one genus, *Conus*, Linné. H. and A. Adams divide them into seven genera; Gray retains three; Keferstein, Deshayes and others, two (*Conus* and *Dibaphus*), as

did also Chenu. The latter author enumerates several sub-genera of *Conus*. It is, indeed, difficult to say, without a very extensive knowledge of the different species, whether a division of *Conus*, in the old sense, be necessary or not. What appears to be really the fact, is this, that the division, if necessary, must be very great, based on the principal variations in the form of the shells; otherwise it would be better to have no generic sub-division at all. For my own part, I believe that a farther division, even if slightly indefinite for the present, would be of very great service; and I have no hesitation in saying, that some division similar to, or the same as that proposed by H. and A. Adams, will be quite essential. It is true, so far as our present knowledge goes, that (excluding *Dibaphus*) the animals scarcely admit of any further separation than into *Conus* and *Nubecula* (or *Tuliparia*).

About 300 living species, belonging to this family, are known; of these, nearly one-half are inhabitants of the Eastern Seas. Of tertiary species, which, on the whole, resemble the living forms, about 90 have been noticed. Deshayes describes in his last work 20 species from the Paris basin alone.

Pictet* enumerates six cretaceous species, *C. cenomanensis*, Gueranger, *C. tuberculatus*, Duj. *C. marticensis*, Math. *C. cylindraceus*, Geinitz. *C. semicostatus*, Münst., from Europe, and *C. canalis*, Conrad, from America. All these species, excepting the *Conus tuberculatus*, to which we shall refer hereafter, are based chiefly upon casts, not in a peculiarly good state of preservation, and several of them are rather doubtful. In this doubtful state, they must remain until better materials are procured. I could add the *Conus Verneuilli*, Vilanova (Mem. Real Acad. Madrid 1859, Vol. IV, Pl. 3, Fig. 12), which can be as well an *Actæonina*. Gabb has lately described three species from California (Palæontol. 1864, I, pp. 122 and 123), *C. Rémondi*, *C. Hornii* and *sinuatus*, all of which are pretty well preserved and appear to belong undoubtedly to this genus.

It is rather remarkable that we have not a single species of *Conus* to notice from the cretaceous deposits of Southern India, although numbers of them, at the present time, inhabit the Bay of Bengal. The single species procured belongs to another genus of this family, only found fossil, so far as known, and for which I proposed in 1865 the name *Gosavia*.

Of species of *Conus*, older than cretaceous, we know scarcely anything. The jurassic *Con. Cadomensis* and *abbreviatus* of Deslongchamps are referred by D'Orbigny to *Actæonina*, although no decided proof can be given that they are not *Conus*. The *Conus? minimus* of d' Archiac belongs probably to *Cylindrites* or to an allied genus of the Opisthobranchia.

* Pal. Suisse, 3. Ser., 2nd part, 1864, p. 689.

XII. GOSAVIA, *Stoliczka*, 1865.

Sitzungsberichte k. Akademie der Wissenschaften, Wien. Vol. LII, Revision. p. 76.

Gos. testa convoluta, spira turbinata, ultimo anfractu inverse-conico; apertura angusta elongataque, basi emarginata; labro prope suturam insinuato, labio plicoso, plicis anterioribus fortioribus.

The characteristic distinction of the genus *Gosavia*, which has been proposed by me in the revision of the Gosau Gastropoda (1865, loc. cit.) for a species previously described by Zekeli as *Voluta squamosa*, consists in the plication of the inner lip. The form of the shell is quite similar to that of a *Conus*, and also the notch of the outer lip near the posterior suture, when compared, for instance, with *Conus marmoreus* and others. The spiral striation seems to be rather peculiar, although indicated in a few species of *Conus*. The folds belong to the callosity of the inner lip, and have nothing to do with the striation, so that through this development a certain transition seems to be formed from the *Conidæ* to the *Volutidæ*. Attaching great importance to the characteristic form of the shell of a *Conus*, we think it rather more probable that the animal of *Gosavia* was more like that of a species of this family, than of the *Volutidæ* or *Pleurotomidæ*, between both of which it seems to form a passage.

The long-known *C. tuberculatus* is most nearly related, in its ornamentation, to *Gosavia*, but no plaits have as yet been observed on the columella of this species, although there is no positive proof that they do not exist. Our Indian fossil is the second known cretaceous species of this genus, the first above referred to, *Gosav. squamosa*, having been described from the Alpine Gosau formation, which may be considered of about the same age as the cretaceous deposits of South India. Another cretaceous species which may belong to the genus is the *Mitra Limburgensis*, Binkhorst (Monog. foss. Limburg., p. 66, Pl. II, Fig. 8); but this species, as described, has plaits only in the middle of the columellar lip, with a remarkably different kind of disposition, and has apparently no notch on the outer lip.

I am not at present aware that either in European or American tertiary strata any species occur, which could justly be referred to this genus, but it seems to have been much more numerously represented in the older tertiary beds of India. It is not improbable that the existence of several species in European tertiaries also, may, after a time, be established. Any person who has given attention to this matter will have seen, that the greatest care is required in the preparation of a specimen in order not to injure the columellar plaits. It would indeed necessitate the admission of no ordinary succession of phenomena, if it were really a fact, that forms which existed during the cretaceous period both in Europe and India, should have so largely increased in number in the latter portion of the earth's surface, while they disappeared altogether from the former, although at the same time the eocene faunæ of both countries afford many very striking similarities, and not a few specific identities.

D'Archiac (Groupe Nummulitique de l'Inde, 1853) describes the following species, which I do not see how to separate from *Gosavia*, but which exhibit very remarkable differences from *Voluta*, or any other known *VOLUTINÆ*, both as to their form and the distribution of the columellar plaits over the whole extent of the inner lip, the anterior plaits being always the strongest: *Voluta dentata*, Sow. (*loc cit.* 324, Pl. 32, Fig. 2, Pl. 33, Fig. 11); *V. Haimei*, D'Archiac (p. 325, Pl. 31, Figs. 26 and 27); *V. Sismondai*, D'Arch. (326, Pl. 31, Fig. 25); *V. multi-dentata*, D'Arch. and Haime (326, Pl. 32, Fig. 1); *V. Humberti*, D'Arch. et Haime (327, Pl. 34, Fig. 9); *V. Salsensis*, D'Arch. and Haime (328, Pl. 34, Figs. 10 and 11). There may be a doubt whether the beds from which these have been obtained be truly Nummulitic. On this point I can only refer to the repeated statements of D'Archiac, that Nummulites occur with them. And if in other respects these beds contain Nummulitic fossils, i. e., are eocene, there is no reason for doubting that those shells must be of the same age. We have in our (Geological Survey) collections good specimens of *Vol. dentata*, and these are generically identical with the cretaceous *Gosavia:* of the other species, I have seen only doubtful casts of *V. multidentata.* I may, however, take this opportunity of mentioning, that I know of several strong indications of the occurrence of cretaceous deposits in the Punjab and Scinde.

The sole living representative of *Gosavia* appears to be *Imbricaria*, Schum. (*Conohelix*, Swains). Neglecting the notch on the posterior lip in the former, and its interior crenulation in the latter genus, the resemblance is indeed very marked; and as the animal of *Imbricaria* and *Cylindra* are in some respects different from other *MITRINÆ*, it may after a while be found convenient to unite these three genera into a separate group, placing them intermediately between the *CONIDÆ* and *VOLUTIDÆ*. When the teeth in any of the species of the two last mentioned genera have been recorded, it can then be easily settled whether they are better kept separate, or be added as a sub-division of the *CONIDÆ*, to which, I cannot help thinking, they seem to have more relation than to the *MITRINÆ* of the *VOLUTIDÆ*.

1. GOSAVIA INDICA, *Stoliczka*, Pl. VI, Figs. 3, 7, and 8.

Gos. testa conica, elongata, spira brevi, acuminata, fere tertiam partem totius altitudinis formante; anfractibus senis seu septenis, sutura impressa sejunctis, superne parum excavatis, inferne seu prope medium carinatis: carina tuberculata; superficie spiraliter striata: striis latis, prope suturam atque in carina ternis tenuioribus, transversalibus partim interruptis, nonnunquam lamellosis; apertura angusta, recta; labro antice producto (Fig. 5. a.), postice ad carinam insinuato; labio calloso, multiplicato; plicis anterioribus fortioribus, approximatis atque obliquioribus quam posterioribus; canali ad terminationem (?) emarginato.

Height of last whorl of the largest specimen found, 45 mm. and probable total height 65 mm.

This species in many respects resembles the European *Gosavia squamosa.* The spire is elevated, consisting of six or seven volutions, the last of which measured

about two-thirds of the total height; they are separated by a deep sutural impression. The upper portion of each whorl is somewhat excavated, to which follows, under the middle, a rounded keel ornamented with 12-15 sharpened tubercles. The entire surface is covered with spiral striæ, which are above on the excavated portion and on the keel much thinner, on the last whorl broad and flattened. Where they are crossed by the lines of growth, they present a scaly laminated structure, if well preserved, otherwise the striæ appear to be granulated or at least somewhat thickened at short intervals. This kind of ornamentation is exactly the same as in *Gosavia squamosa*.

The aperture is narrow and straight. The outer lip is expanded anteriorly and deeply insinuated posteriorly on the keel; the lines of growth being bent in the same manner and the successive stages of growth producing the tubercles on the keel corresponding to the emargination. The inner lip is rather thickened, especially anteriorly, and plaited over its entire extent; the upper plaits are thin and distant, the anterior becoming however very thick and strong, and gradually more oblique, as they approach the anterior extremity, which unfortunately is not perfectly preserved in any of our specimens, but it could scarcely differ from that of *Conus*. There are generally about eight or nine plaits, the three upper ones thin, the five or six lower ones stronger. I have not been able to trace in the European *G. squamosa* more than three strong plaits, but there may be some more thinner ones. Besides this, the European species differs by having the keel ornamented with more numerous and thinner tubercles, placed nearer to the upper or posterior suture, the reverse of which is the case in the Indian.

Localities.—West of Kullygoody, near Serdamungalum, and between Andoor and Veraghoor; not uncommon.

Formation.—Trichinopoly group, but close to the boundary of the Arrialoor, with which the light coloured sandstones agree better in their mineralogical characters.

VIII. *Family,—VOLUTIDÆ.*

The three groups of shells, known under the generic names of *Voluta*, *Mitra*, and *Marginella*, as introduced by Lamarck, are commonly regarded as the chief representatives of this family; but there exists no little controversy on the subject of the classification of the forms, which ought to be admitted or excluded.

All the shells belonging to the three genera named above have a *certain solid structure, the surface being often totally or partially covered with a thin enamel coating as in the* CYPRÆIDÆ*; the spire is generally very short as compared with the size of the last volution; the anterior extremity is notched and occasionally produced into a short canal, and the inner lip is provided with columellar plaits in all stages of growth.*

Several families have been established, more on account of some differences which occur in the animals, than in the shells, although none of these seem to justify the necessity for such a step. The considerable difference between the animals

of *Mitra* and *Voluta* lies in the dentition; the teeth in *Mitra* being in three series, and in *Voluta* and *Marginella* in only one. I shall, however, further on notice a few points, which would appear to be more conclusive that *Mitra* ought to be classed with the *Volutidæ*, rather than with the *Fasciolaridæ*, as proposed by Gray.

Viewing the large number of fossil species described under *Mitra* and *Voluta*, we may without hesitation assert, that it is impossible to carry out such a distribution into families, where often even the generic determination of species must remain doubtful. It would appear to give a sufficient exposition of these differences, if we accept four sub-families, viz., *marginellinæ*, *volutinæ*, *volutomitrinæ* and *mitrinæ*; and we shall therefore treat them accordingly. Deshayes recently* admitted *Voluta*, *Mitra* and *Columbella* into the family of *Volutidæ*, and strongly advocates the exclusion of *Marginella*. He criticises Dr. Gray's classificatory changes very sharply. These, however, ought rather to be duly acknowledged, as indicating a steady progress in science; for it yet remains to be seen, how many followers Deshayes will find for his own classification.

a. *Sub-family*,—*MARGINELLINÆ*.

The animals of *Marginella* and allied genera are no doubt closely related to those of the *Cypræidæ*, the tentacles being long, close together, bearing the eyes near their basis, or within the first half of their length, above and externally on small bulgings; the siphon is of moderate length, simple at the base; the teeth on a lingual membrane, band-like, with numerous conical dentitions (resembling in form the lateral teeth of the *cypræinæ*); foot large, expanded, truncate in front; mantle enveloping the greater part of the shell and covering the same with an enamel coating; no operculum.

The shells are usually of small size, solid, ventricose, strongly involute, and, in full grown state, occasionally even convolute; exterior surface mostly smooth; anterior extremity not produced, only notched; mouth linear, outer lip often thickened and toothed internally, inner lip always with numerous plaits in all stages of growth.

The *marginellinæ* as restricted exhibit a great variety of form, and there appears every reason why the old genus *Marginella* of Lamarck ought to be separated into several smaller divisions (some of which are very characteristic, as stated by H. and A. Adams) under *Marginella* and *Persicula*. There is, however, no inducement for us to enter here into any discussion as to the value of those so-called sub-genera. Besides the species quoted by Adams under *Marginella* and *Persicula*, we think only those of *Volvaria* and *Volvarina*, Hinds, have to be admitted within the limits of this sub-family. The genus *Volvaria* ought to be restricted, as

* Paris fossils, 1865, III, 572.

Deshayes very properly observes (vide Anim. s. vert. bas. de Paris, III, p. 541) to those species only which have the margin of the outer lip not thickened, while for those forms which have a thickened outer lip, like *Marginella* and others, but only a few anterior plaits on the columella, Hinds' name *Volvarina* could remain in use. Gray (Guide, 1857, p. 30) retains *Volvaria* in the same sense, and does not acknowledge any living representative of the genus, while Deshayes knows two living species, one of which is the *Volvaria pallida*. It cannot be questioned that, as regards the general form of the shell, the fossil genera *Actæonella*, *Volvulina*, *Cylindrites* and others show the greatest relation to *Volvaria* and *Volvarina*; there are, however, some very important reasons, which urge the classification of these fossils in the group OPISTHOBRANCHIA. We have already (page 58) referred to *Erato*, Risso, advocating the view of its belonging to the *CYPRÆIDÆ*. *Pachybathron*, Gask. appears to be more successfully classed by Gray and Chenu in the family *CASSIDIDÆ*.

As I have already stated, Deshayes is determined, after a *repeated and minute examination* of the forms of all the *MARGINELLINÆ*, to class this group of shells with the *CYPRÆIDÆ*. Deshayes proposes this, I believe, only on the ground of the external similarity of the animals in preference to all other distinctions. Let us consider the animal first: In *Marginella* (restricted) the animal has long tentacles, and an expanded mantle, enveloping the shell as in all other *CYPRÆIDÆ*, but the mantle is quite as much expanded in the true *VOLUTIDÆ* also (as for instance in several of the species of *Melo* and *Scapha*); it is, however, always smooth on the exterior surface, and not provided with those *filamentous appendices*, which are very characteristic for by far the greatest number of the *CYPRÆIDÆ*. If the length of the tentacles (and they are not so very long in several other true *Marginellæ*) ought to be taken as a conclusive distinction, how is it possible for Deshayes to maintain the unity of the genus *Marginella*, and not to separate even generically *Persicula*, the animals of which are decidedly more like *VOLUTINÆ* than *CYPRÆINÆ*? Looking further to the dentition of the radula, we find no support whatever for such a transfer of *Marginella* to the *CYPRÆIDÆ*. The shell of *Marginella*, which has columellar plaits during all stages of growth, is by this character alone decidedly more nearly related to the *VOLUTIDÆ* than to the *CYPRÆIDÆ*, in which the dentition of the margins appears only in stages of maturity. Besides this, the outer lip in many *MARGINELLINÆ* has only a thickened and shelving outer edge and is not involute, as, without exception, it is in the *CYPRÆIDÆ*.

Not many fossil species of the *Marginellinæ* are known. They appear to have been more numerous in the eocene period than in the neogene, but none are as yet known from the cretaceous strata. The single species *Marginella involuta*, Zekeli,* from the Alpine Gosau deposits has been shown to be a *Cypræa*, or at least to belong undoubtedly to the sub-family *CYPRÆINÆ*.†

* Abh. Geol. Reichs Anst. Wien, 1852, I, p. 65, Pl. IX, Fig. 11.

† Sitzb. Akad. Wien, 1865, Bd. LII. Revision etc. p. 64.

b. *Sub-family,—VOLUTINÆ.*

We accept this sub-family in the same sense as Adams' *VOLUTIDÆ*, Gray's *VOLUTINÆ* or Chenu's *Voluta* with a large number of sub-genera; and as all the principal forms are amply illustrated and noticed in Chenu's Manual, it will be sufficient to refer to that publication.

Chenu enumerates sixteen sub-genera, the greater part of which, we think, ought with full reason to be admitted as equivalent to generic distinctions; it will even be necessary to increase this number, when all the known fossil species shall have been properly attended to. Further sub-divisions of the whole group, as those of *YETINÆ*, etc. Gray, or *CYMBINÆ* and *ZIDONINÆ*, Adams, may be convenient, but the characters upon which they are based seem to depend very much on local modifications of one and the same shell (as in *Cymb. proboscidale*, or in *Melo ethiopica*) and must, therefore, always be of subordinate importance. The known fossil species do not give much support to these minor sub-divisions, although I have no hesitation in saying, they may be found both convenient and useful.

The animals of the *VOLUTINÆ* are all remarkably similar in form; they have a large head with short stout tentacles, distant at their basis and united by a broad veil forming a hood over the head; the eyes are usually on thickened bulgings behind the base of the tentacles; the siphon is of moderate length, usually re-curved, and with more or less developed auricles on each side of the base, sometimes partially connected with the veil. The mantle is enlarged all round, as in *Cymbium*, *Melo* and others, covering the greater portion of the outer shell-surface with enamel, similarly to what has been already noticed in the *MARGINELLINÆ*; but it does not seem to have any filamentous appendices on the exterior surface, as in the *CYPRÆIDÆ*. Sometimes it is expanded only on one, the columellar side, as in *Volutella*, D'Orb. The foot is generally of a simple triangular shape, adapted for creeping, truncate in front and prolonged posteriorly, as in the greater number of the remaining sub-families.

The teeth are on a lingual membrane in one series only. A horny operculum has been observed by Gray in the genus *Voluta*, as restricted to species like *V. musica*, and lately by Crosse in several species of *Lyria*. (Vide Journal de Conchyliol. 1866, 3 ser., Vol. VI, p. 105.)

The variety in form of the shells is very great, but they are so gradually connected with each other, that very great difficulty is experienced even in separating the known living species into the genera, as given in Chenu. A marked character of the shell of all *VOLUTINÆ* is the relatively *great size of the last volution, the mamillate apex, and the anterior plaits of the columellar lip being stronger than the posterior.* Only where these characters have been observed, does there seem to be full reason for referring the fossil species to this sub-family. Of the cretaceous species many belong to *Volutilithes* and *Lyria* (the same is the case with the lower tertiary species): these two genera are, however, exactly those which form a gradual passage to the *FASCIOLARIDÆ* and the *MITRINÆ* respectively. When in some

species of *Lyria* the plaits are not well developed, or in the fossil state not exactly to be observed, there is no possibility of distinguishing those shells from others, which are attributed to *Turricula* and other genera of the *MITRINÆ*. As to *Fasciolaria* and *Volutilithes*, the more elongated and narrow canal and the greater height of the spire of the former usually serve as more easily recognized differences.

Looking to all the known cretaceous species of the *VOLUTINÆ* we venture to say, that besides *Volutilithes* and *Lyria*, which are the most numerous, several other genera appear to be represented. In spite of the greatest and most marked resemblance in the exterior form of the shells, there is very often a smaller number of columellar plaits to be observed, as compared with the recent representatives. We can scarcely think that this character, which is so very much dependent on the good preservation of the fossil, could be admitted as conclusive, although the difference ought always to be recorded. Several of the cretaceous species may form new generic types. We cannot, however, anticipate much success in an attempt to classify the known cretaceous species, in accordance with the present state of conchological science, because many of them are known only from very deficient specimens, and until this be remedied, the general term *Voluta* will often be most acceptable. At the same time we should not feel justified in reporting on such interesting material, belonging to the *VOLUTINÆ*, as we have from the South Indian cretaceous rocks, did we not avail ourselves of the opportunity of showing, that such a division into more specified and restricted genera is not only necessary, but that the existence of such distinctions can be traced even in this remote period. We shall therefore carry out this division in our special case, so far as it appears advisable.

Deshayes, as usual, very much favours the unity of a 'grand' genus *Voluta* in Lamarck's sense, although it is difficult to see with what advantage. It cannot be said to add to our detailed and specified knowledge, though no conchologist will deny, that all the numerous species described and known as *Voluta* belong to one group. The question will soon be reduced again to what authors may choose to call a genus, or a sub-family, family, or tribe. On page 583, M. Deshayes himself, after having discussed and established the unity of the genus *Voluta*, proposes five divisions or groups of this *Voluta*, and says they appear to be 'useful,' as we think no one will hesitate to admit. But if 'useful,' they must be definable by some characteristic distinction; and if this be once admitted, the desirability of a sub-division of Lamarck's genus *Voluta* is abundantly established. Only the far less important question will then remain, whether we prefer to call such groups by a fixed and definite name, or to mark them by a letter *a*, *b*, *c*, &c., and whether we carry the definition to a greater or lesser degree of strictness, for the convenience of further determinations. I believe it to be merely a matter of opinion and convenience, as to which of these systems tends most to our progress in the knowledge of different types of shells. I am of course well aware that many conchologists believe themselves fully satisfied, that the genera in our zoological and botanical literature are and must be more than groups of necessary convenience, but it will soon be very difficult for them to find much support for these views. That this—I mean mere

convenience—is actually the case with many of our so-called genera of *shells*, cannot be questioned, but it is the study of the development of organic beings, which must be the essential guide in adopting a nomenclature in accordance with the progress of natural science.

Pictet enumerates (Mat. Pal. Suisse. 3 me. ser., 2 pt., pp. 679—681) 42 cretaceous species of *Voluta* from Europe, and several from other countries. But these numbers must submit to very considerable changes. We shall note here the principal alterations which seem desirable, and some additions which have been made known since.

The first 12 species noticed by Pictet—if Gueranger's and D'Orbigny's species (in "Prodrome") be correct—will probably stand. The *Voluta elongata*, D'Orb. (see *Fulguraria* id. page 87) is not identical with *Fasciolaria elongata*, Sow., which species must provisionally remain as a *Fasciolaria*.

Voluta deperdita, Goldfuss, is probably a *Fulguraria*.

The next six species, from the German cretaceous deposits, are all more or less doubtful, but nothing can be done with them at the present. Extensive comparison and careful examination of better materials will alone enable a final disposal of these doubtful names.

The species given by Pictet as Nos. 20—35 and described by Zekeli from the Gosau deposits have been critically examined by myself,* and reduced to the following species: *Volutilithes fenestrata*, Zek.; *Voluth. acuta*, Sow. (*V. subacuta*, D'Orb., *V. Bronni*, *fimbriata* and *gibbosa*, Zek.); *Voluth. Casparini*, D'Orb.; *Voluth. (Fulguraria) elongata*, D'Orb.; *Voluth. coxifera* and *carinata*, Zek. The Gosau deposits, therefore, add only four new species to the number already known.

Müller reported four additional species from the cretaceous beds near Aachen (Aix la Chapelle), of which the *Vol. cingulata* and *Benedeni* are rather more like *Fasciolariæ*, although they may belong to *Volutilithes* or an allied genus. *Mitra Murchisoni* of Müller, belongs probably to *Fulguraria*, and it is even very questionable if it be really different from *Ful. elongata*, D'Orb. The *Mitra pyruliformis*, Müller, probably belongs to our new generic type, *Ficulopsis*, in which case it must be transferred to this sub-family. Careful examination would also seem to bring in a similar change with *Melongena rigida*, Müller (ibid. p. 78, Pl. 3, Fig. 22), which may belong to *Volutilithes*. Thus the number of species from Aachen may be five or six, when these proposed alterations can be better established. Binkhorst describes, in addition to the *Voluta deperdita*, Goldfuss, three new species, of which the *V. monodonta* is very much like the Gosau *V. acuta*, Sow., and may prove identical.

With these alterations we admit not more than about 32 species as at present known from the cretaceous rocks of Europe, and of these, I believe, only one is as yet known from England.

The *Voluta rigida*, Baily, from South Africa, has been identified by me with a South Indian *Fasciolaria*, but, on the other hand, three species have to be noticed from Algiers, described by Coquand.† These are *Voluta Baylei*, *algira* and *pusilla*.

* Sitzb. Akad. Wien. 1865, Bd. LII Revision, pp. 70, &c.

† Geol. et. Paleon. Constantine, 1862, pp. 182 and 183, Pl. II, Fig. 11, Pl. V, Figs. 10 and 11.

From America a large number of forms belonging to this sub-family is known. Gabb, in his catalogue,* enumerates three species of *Voluta* and ten species of *Volutilithes*. But I am afraid that all those species with "surface markings unknown," and represented in outline only (such as *V. biplicata, nasuta, &c., &c.*), will ever remain dead letters to any subsequent observers, unless better descriptions and figures, or rather better specimens, be supplied. In his Palæontology of California (I, p. 102) Gabb describes one species previously named by Shumard, *Volutilithes* (*Volutalithes*, p. 243) *Navarroensis*. Other American species may have been published, which I have not had an opportunity of becoming acquainted with.

The ten Indian species described by Prof. E. Forbes† have, during our recent examination, led to a totally different arrangement from that proposed by D'Orbigny. I have retained only *four* of E. Forbes' species in this sub-family. The *V. Trichinopolitensis* I have identified with *Fulguraria elongata;* two species, *V. septemcostata* and *cincta* of Forbes, I have not been able to identify at all, nor can I add anything to the knowledge of them. They must stand provisionally as placed by E. Forbes. *Voluta citharina* I have transferred to the sub-family MITRINÆ and *V. Camdeo* and *breviplicata* to the CANCELLARIDÆ. On the other hand, I have added to this sub-family the *Pyrula Pondicherriensis*, Forbes, under a new generic name, *Ficulopsis*, and nine other species chiefly belonging to *Lyria* and *Volutilithes*. Thus the total number of VOLUTINÆ, from the South Indian cretaceous rocks, as given in this paper, amounts to fifteen species, which will be found described under the following names: *Scapha attenuata* and *gravida; Melo pyriformis; Ficulopsis Pondicherriensis; Fulguraria elongata* and *multistriata; Volutilithes accumulata, latisepta, muricata, radula; Athleta purpuriformis* and *scrobiculata; Lyria granulosa, crassicostata* and *formosa*.

Supposing now that the determinations, as here given, are, at least with regard to the sub-family, correct—a supposition which I believe is fully admissible on this point—and allowing on the other hand for the small area, wherefrom these fossils have been obtained, we may still without much hesitation form the conclusion, that *the East had already during the cretaceous period a richer fauna of* VOLUTINÆ *than the West*, an observation which holds correct also during the present geographical distribution of the different species. The VOLUTINÆ were fast disappearing from the Western seas, and were gradually more limited to those of the East, most probably, because the Eastern waters had preserved a higher temperature. So, for instance, the Vienna basin was inhabited during the miocene (neogene) period by several species of VOLUTINÆ, while almost every trace of them disappeared in the Mediterranean Sea. Similar observations have been made in other parts of the European seas.

I may take here the opportunity of mentioning, that several species of VOLUTINÆ are known to occur in the cretaceous deposits of the Nerbudda valley

* Proc. Am. Phil. Soc. VIII, pp. 149 and 150.

† Trans. Geo. Soc. London, 2nd. Ser. VII.

and near Cherra-Poonjee (North-East Bengal), the fossils of both of these localities awaiting examination as soon as those of the South Indian cretaceous deposits have been completed.

We have thus about 64 *species of* VOLUTINÆ *known from cretaceous deposits*, of which not a single one has yet been found to occur in the lowest cretaceous or Neocomian beds. It is also very remarkable that, except some doubtful casts, no species have been traced in the lowest beds of the Indian cretaceous deposits—the Ootatoor group, although several species are well known from the cotemporaneous (?) beds, containing *Ammonites inflatus*, *Mantelli*, *&c.*, in European districts. It must not be forgotten, however, that in other respects also, our Ootatoor beds have yielded only a small number of Gastropoda and Lamellibranchia, and these for the most part only in poor casts. We are thus led to expect, that this discrepancy will find its solution rather in a local geological explanation, than in any difference of time, as would be suggested by the present definition of the several groups.

The *Melo pyriformis and Ficulopsis Pondicherriensis* have, it is true, been found in the Pondicherry sandstones, which are usually classed in the Valudayur group, but as I have already stated, there is some discrepancy in the distinctions of the different strata of these sandstones, and among the so-called Valudayur group beds of more recent date, corresponding in age with the Arrialoor group, seem to be still included. Equally doubtful is the occurrence of *Fulguraria elongata* in the Ootatoor beds.

We shall now proceed to a more detailed description of the species, confining, however, our remarks only to those genera which are represented in the present series of our cretaceous fossils.

XIII. SCAPHA, Klein, 1753; *Gray*, 1857 *(?)*

(H. and A. Adams' Genera, II, p. 616, Appendix 1: Gray's Guide, 1857, p. 33.)

The four sub-genera distinguished by Gray in this genus can be only approximately defined, and in the determination of the fossil forms, there seems scarcely a possibility to retain them, unless our materials are very much more complete than now. From the want of the small posterior plaits on the inner lip and of an operculum, there is full reason to separate these forms from *Voluta* proper, to which they are most nearly related. The shell is usually smooth or only obsoletely sulcated spirally; the number of columellar plaits varies from three to five.

I do not know a single cretaceous species, which could with any certainty be referred to this genus; and even of the two, which we here refer to the same, only the *Sc. gravida* has strictly speaking claims to it, the form of the shell of the second species being rather unusually much elongated. But as the other characters agree, it may stand here provisionally, until fully preserved specimens settle the question. The *Volu. Requieniana*, D'Orb., presents a similarity in ornamentation, but the general form is so very different that the species, as it appears to have been based upon a rather perfect specimen, may better be retained as *Volutilithes*.

1. Scapha attenuata, *Stoliczka*. Pl. VI, Figs. 4 and 5.

Scaph. testa ovate elongata; anfractibus septenis, ad suturam impressis, sublævigatis, supra medium tuberculatis: tuberculis crassis, antice in costas prolongatis, attenuatis, circiter octonis in uno circuitu; ultimo anfractu spiræ in altitudine fere equali; apertura compressa, antice effusa, in labii margine plicis ternis obliquis, conspicuis ornata; canali brevi.

Spiral angle about 35°; sutural angle 13°.
Height of last whorl: total height of shell (considered as 1·00) 0·48.

An elongated shell, composed of about seven volutions, the last of which is nearly of the same height as the spire. They are slightly convex, contracted at the posterior suture, and each of them ornamented with 8-9 strong, above the middle rather sharply tuberculated, ribbings, which on the last whorl do not extend anteriorly beyond the middle. The surface is only obsoletely spirally sulcated. The margin along the suture is occasionally thickened, and the keel below the same on the last whorl smooth, losing all the previous tuberculations (as seen in Fig. 5). The aperture is equally elongated as the shell, laterally compressed, the canal being comparatively short. On the inner lip three oblique folds have been observed, the first anterior being the strongest.

The specimen represented in Fig. 4 is, except on the apex and the extreme margin of the outer lip, quite complete. The more elongated form combined with a different shape of the whorls, and especially the rib-like tubercles, do not admit of our uniting this form at present with the *Scapha gravida*, which also differs by a larger number of folds on the columella, being four, while in the present species they do not exceed three, of which only the two anterior are stronger. The elongated form does not agree with living species of this genus, as already stated.

Locality.—Kolakonuttom, from a yellowish clayey sandstone, and east of Anapaudy; few specimens were found.

Formation.—Trichinopoly group.

2. Scapha gravida, *Stoliczka*. Pl. VI, Fig. 6.

Scaph. testa ovata, crassa, spira brevi, subacuta; anfractibus læviusculis, prope medium angulatis atque tuberculatis: tuberculis circiter 8 *in uno circuitu, antice versus in costas plus minusve prolongatis, crassis; labio antice quadriplicato.*

Spiral angle 65°; sutural angle 14°.

The shell of this species is somewhat thicker than that of most of the living species, but the broadly ovate form is the same. The whorls are angulated near the middle, and each provided with eight or nine strong and thick tubercles, which are prolonged anteriorly into as many short ribs. On the last whorl, which is higher than the spire, these ribs disappear gradually towards the anterior termination. The sutures are undulated according to the elevations of the ribs; the shell is otherwise perfectly smooth, save the fine striæ of growth. The inner lip exhibits four oblique folds, the first of which on the edge of the canal is the smallest and the next the

strongest. Of this species we know only the figured specimen, which, although characteristic enough, is in many respects imperfect; the termination of the anterior extremity and the outer lip not being preserved, have been restored in outline according to their probable shape.

Locality.—From a white sandy limestone near *Ninnyoor* in the Trichinopoly district.

Formation.—Arrialoor group.

XIV. MELO, *Humphrey*, 1797.

(H. and A. Adams' Genera I, p. 159; II, p. 616; Chenu's Manual, I, p. 186.)

The *ventricose form and the callose covering* are characteristic for the species attributed to this genus, in which certain sub-divisions, at least two, according to the presence or want of spines on the posterior portion of the outer lip, must be allowed to be of great convenience; it would probably be better to retain only the species with the former character under the name *Cymbium*. There are several upper and lower tertiary species, which belong to this genus, but the cretaceous species to be now described is to our knowledge the only secondary representative. It bears in every respect the characters of the genus, and is on the whole much like our *Melo indica* of the neighbouring seas, so much indeed, that this can be regarded as only an offspring of the fossil species.

1. MELO PYRIFORMIS, *Forbes, sp.* Pl. VI, Fig. 9.

1846. *Voluta pyriformis*, Forbes, Trans. Geol. Soc. Lond. VII, p. 130, Pl. XII, Fig. 1.
„ „ D'Orbigny, Gabb, Pictet and others.

M. testa pyriformi, spira brevissima, late conica, callositate plus minusve tecta; anfractibus quinis, fere planis, sutura impressa sejunctis, primis mamillatis; ultimo inflato, antice valde prolongato, attenuato; superficie polita, lævissima; apertura elongata, postice acuta, antice effusa; columella callosa, quadriplicata: plicis antice versus obliquioribus atque fortioribus.

Spiral angle 90°—100°; sutural angle 5°—8°.
Height of last whorl: total height (taken as 100) 0·80—0·90.

This fine species approaches, as already stated, very closely to *Melo indica*, Gmel., one of the typical forms of this genus. The embryonal whorls are somewhat enlarged, resembling a mere globule; the others are nearly plane, and impressed along the suture, somewhat contracted about the middle; the last whorl envelopes the greatest portion of the previous, leaving a very short broadly conical spire visible. Usually there are only about five volutions present. The shell is very thick throughout, but especially along the suture, where it reaches high up on the preceding volution. In a perfect and probably full grown state, it was covered with an enamel coating, giving thus to the surface a smooth and polished aspect, in which case the sutures are marked with only obsoletely impressed lines. When this coating is removed, the fine striæ of growth and also the sutures become clearly visible.

The callose inner lip exhibits four plaits, which become gradually more oblique and at the same time stronger towards the anterior emargination of the aperture. The first fold next to the canal is the least visible on the aperture, although it is the strongest more internally. The margin of the outer lip is somewhat enlarged, and, so far as can be seen from some fragments, sharpened from inside.

The largest specimen from Pondicherry is in the Madras collection: it measures 95 mm. in height and 65 mm. in width on the last volution.

Localities.—West of Kullygoody and Pondicherry; not common.

Formation.—Trichinopoly and (?) Valudayur groups.

XV. FICULOPSIS, *Stoliczka*, 1867.

Ficulop. testa pyriformi, antice attenuata, postice inflata; spira brevissima; superficie spiraliter atque transversim striata vel costulata; columella crassa, extus atque antice angulata, intus applanata, plicata.

Under the above name, I propose to class the Indian species described and figured by Forbes as *Pyrula Pondicherriensis* and figured by D'Orbigny as *Pyrula carolina*. The shell exteriorly in form and appearance does not differ from typical species of *Ficula* as restricted (*Pyrula* or *Sycotypus*) being reticulated on its surface and having a very short spire. While, however, the columellar margin in *Ficula* is very thin, it is in *Ficulopsis* very thick, externally angulated, internally flattened and provided with a number of plaits, of which the anterior are the stronger. This sufficiently justifies the placing of the genus among the VOLUTINÆ. In this respect *Ficulopsis* may be said to combine the characters of *Melo* and *Fulguraria*, agreeing with the former in general form and with the latter in its ornamentation, and especially in the characteristic flattening of the anterior and inner portion of the columella.

The aperture is very long and of the same shape as the shell; anteriorly it is gradually narrowed, and at its termination no doubt emarginate (our specimens are not quite perfect at this point). It is difficult to say whether the *posterior notch of the outer lip*, which exists in the species now described, ought to be included in the generic characters or not; it would probably be better not to do it at present, until some other such characteristic forms have been made known.

I am not aware of any fossil species, which could be fairly attributed to this genus, unless the *Mitra pyruliformis*, described by Müller (Petref. der Aachner Kreide-formation, II, 1851, p. 23, Pl. 3, Fig. 25) from the cretaceous deposits near Aachen, belongs to it, which does not appear unlikely.

1. Ficulopsis Pondicherriensis, *Forbes*, sp. Pl. VI, Figs. 10 and 11.

1846. *Pyrula Pondicherriensis*, Forbes, Trans. Geol. Soc. Lond. VII, p. 127, Pl. XII, Fig. 19.
1847. *Pyrula Carolina*, D'Orbigny, Voy. Astrolabe et Zélée, Pal. Pl. II, Figs. 34 and 35.
1850. „ „ D'Orbigny, *et auctorum.*

Fic. testa elongate pyriformi, spira brevissima, mucronata; ultimo anfractu postice inflato, antice prolongato atque sensim attenuato; superficie costulis spiralibus atque transversalibus fenestrata, costulis ultimis tenuioribus atque in speciminibus adultis nonnunquam subobsoletis; apertura perlonga, postice emarginata, antice late effusa; labro ad suturam insinuato, antice paululum expanso, intus sulcato; labio calloso, quinque-plicato, antice crassissimo, ad marginem exteriorem angulato, intus applanato.

Spiral angle 110°.
Height of last whorl : total height (considered as 1·00) ... 0·91

As regard the peculiar form of this species and its relation to others, we have already, in the remarks on the genus, noticed all that was needed. The five oblique folds are very distinctly visible, and it is even not impossible that there may be more of them. They disappear on the margin of the aperture totally, which misled Forbes and D'Orbigny to describe the species under *Pyrula*. The anterior portion of the inner lip is very much angulated exteriorly and strongly thickened; the folds terminate over nearly its entire extent, as may be seen from the Fig. 10, Pl. VI.

The transversal ribs are in young specimens of nearly equal strength with the spiral, forming on the place where they meet slight tuberculations and dividing the surface in regularly squarish lacunæ. In more largely grown specimens the spiral ribs much predominate on the last whorl, occasionally alternating with secondary ribs. Besides these ribs there are striæ of growth distinctly visible, being along the suture deeply insinuated and causing a similar emargination on the margin of the outer lip. There are four volutions visible on the figured specimen from Pondicherry, but the uppermost are devoid of the shell surface, for which reason it cannot be ascertained, whether the apex was mammillated or not, but if it was, as seems probable, it could have been only slightly so, as compared with other *VOLUTINÆ*.

Localities.—Pondicherry and W. of Kullygoody in Trichinopoly; at the former locality the species appears not to be rare; at the latter only a single fragmentary specimen has been as yet procured.

Formations.—Valudayur- and Trichinopoly- groups.

XVI. FULGURARIA, *Schumacher*, 1817.

(*Vide* Adams' Genera I, p. 165.)

The principal characteristics of this genus lie in the *elongated form, spiral striation, numerous plaits about the middle on the inner lip, much produced anterior extremity with the columellar lip sharpened exteriorly and more or less flattened interiorly.*

There are only three species known living, and for the *Fulg. dubia* H. and A. Adams propose the sub-genus *Aurinia*, although there seems to be scarcely a necessity for this, when the number and form of the columellar plaits actually varies in one and the same species, as appears to be the case.

The two species which we describe here under *Fulguraria* do not differ as regard form and ornamentation in any way from *Fulg. fulgura*, and they are both distinguished by the sharpened anterior margin of the inner lip. In the living species, the inner lateral flattening and the central thickening of the inner lip is by no means so clearly developed, but it is distinctly indicated, and its form in the fossil species can be compared only with that of the living *Fulgurariæ*.

One of the species here described, the *Fulg. elongata*, D'Orb., has only three nearly equally strong columellar plaits, and the other, *Fulg. multistriata*, n. sp., has four, three of which are stronger and the last posterior less oblique. This—the number of columellar plaits—can hardly be said to be a generic difference between the fossil and living species. I have for that purpose compared numerous specimens of the living *Fulg. fulgura*, and I find that there is a good deal of variation to be found in the form and number of plaits, although I never found them to be less than five. Some specimens have distinctly three principal folds; out of eight the two anterior, one between the first and second principal, and two behind the third being considerably thinner; sometimes there are three smaller posterior and one between the second and third principal, so as to raise the number of columellar plaits to nine or ten. Other specimens have the two first anterior small, the third is the strongest and more distant from the others, which amount to from two to five, becoming gradually thinner towards the anterior termination. Considering these changes of the plaits on one side and the great similarity of the entire shell on the other, I believe that the fossil forms ought not to be generically separated, for they must be regarded as the true cretaceous representatives of *Fulguraria*.

Another point, which may be thought of great importance, is the thickening of the posterior margin of the outer lip, its partial insinuation and a corresponding curve of all the striæ of growth below the suture. On account of this character the *Fulg. elongata* has been determined by Römer and others as *Pleurotoma*, and in some respects it recalls *Borsonia*. The insinuations of the striæ of growth may be, however, readily observed in the living *Fulguraria fulgura* too, and they are inseparably connected with the posterior constriction of the whorls; the difference consisting merely in the striæ being only a little more strongly developed near and at the margin of the aperture in large specimens of *Fulg. elongata*, than they usually are in *Fulg. fulgura*.

There are only very few tertiary species, which appear to belong to *Fulguraria*, but a good many of the cretaceous forms may be attributed to this genus, although they certainly require first a careful comparison as to their characteristic affinities with *Fulguraria*. We may mention *Mitra Murchisoni*, Müller. (Petref. Aachner Kreidef. 1851, II, Pl. III, Fig. 23), if it be really different from the *Fulg. elongata*, D'Orb., about which serious doubt must be entertained; *Volut. Navarroensis*, Shumard (Gabb,

Pal. Calif. 1864, I. Pl. 19, Fig. 56), also a similar species to *Fulg. elongata*, but apparently with the transverse ribs very slightly marked, and the whorls posteriorly less constricted; *Voluta deperdita*, Sow. (Binkhorst, Monograph Gast. et Ceph. Limbourg, 1861, Pl. II, Fig. 7 and Pl. 5^{a2}, Fig. 1); *Volutil. Eufaulensis*, Conrad, (Jour. Acad. nat. sc. Phil. 2 Ser. IV, p. 286, Pl. 47, Fig. 18) and others.

1.—Fulgurraria elongata, *D'Orbigny, sp.* Pl. VII, Figs. 1—9.

1843. *Voluta elongata*, D'Orbigny, Pal. Franç. Crét. II. p. 323, t 220, Fig. 3.
(non *Fasciolaria elongata*, Sow.
1846. „ *Trichinopolitensis*, Forbes, Trans. Geol. Soc. Lond. VII 133, Pl. 15, Fig. 5.
1865. *Volutilithes elongata*, D'Orb. sp.; Stoliczka, Sitzb. Akad. Wien, LII Revision etc. p. 74, with references to previous authors.

Fulg. testa fusiformi, elongata, spira plus minusve extensa; ultimo anfractu maximo, postice subinflato, antice valde attenuato; anfractibus omninis ad suturam valde constrictis, infra contractionem angulatis atque infra transversim costatis; costis 12-15 *in uno circuitu, ad angulum plus minusve elevatis seu subtuberculatis, singulis in medio ultimi anfractus atque omminis prope aperturam evanescentibus; superficie spiraliter crasse-striata; striis elevatis acutis, æquidistantibus, ad suturam nonnunquam plus numerosis atque tenuioribus; apertura longissima, postice subeffusa; labro postice ad marginem calloso, parum insinuato, ad medium atque antice subacuto undulateque marginato; labio calloso, ad medium triplicato, extus in margine columellari valde angulato, intus lateraliter plano, ibidem atque postice lævissimo.*

In my revision of the Gastropoda of the Gosau-formation, quoted above, I have given a list of synonyms of all the forms which have most probably to be referred to this species. I have added here the *V. Trichinopolitensis* of Forbes; as, although with some doubt, I can scarcely think that Prof. Forbes could have had another fragment before him. Among all the fossils of our very extensive collection from the Trichinopoly district, there is none other to which it could be referred, and I have figured purposely similar specimens on Pl. VII, Figs. 5 and 6, which are evidently very like Forbes' representation, save in the size.

The above description refers to the numerous specimens in general, but there are several very marked variations to be recorded. We figure the principal of these, and although it would appear that there could be no great difficulty in distinguishing at least three distinct species, we are fully convinced that it is impossible to do so, except by ignoring all the intermediate forms. We have compared several hundred specimens from the Trichinopoly district, and all of them agree in the specified characteristics. The spiral striæ, being usually on the last whorl all of equal strength and distant from each other about twice their thickness, are very characteristic. Occasionally they become obsolete in large specimens, except on the anterior portion of the last whorl (see Fig. 5), or in other more inflated specimens they alternate with somewhat thinner ones (see Fig. 7). The striæ of growth are occasionally more strongly marked and partially intersect the spiral striæ. On the

contracted portion of the whorls next the suture they are always distinct, often laminated and bent inwards, according to the thickened margin of the respective portions of the outer lip. On this same portion of the whorls, the spiral striæ are occasionally more numerous and finer; sometimes there are only three of them, equally distinct, or even two only close together near the suture; rarely they are wanting entirely. All these variations are not at all connected with the form of the shell, but they depend very often upon the state of preservation, or on the age and on the strength of the striæ of growth.

On larger grown specimens the posterior portions of the outer lip remain so strongly marked, that they cause every other ornamentation to become obliterated (see Figs. 4,9*a*.). The anterior portion of the outer lip is sharpened, and according to the elevation of the exterior striæ undulating on its margin and internally sulcated. The inner lip is thickened, and its callosity often extends over the entire fore-part of the last whorl. There are, without exception, so far as has been observed, only three oblique folds present, and the interior portion of the columella is very much flattened, flanking the side of the aperture nearly perpendicularly and bearing the folds so far internally, that there is barely a trace of them perceptible in the apertural space on the perfect shell. The embryonal whorls are smooth, but not so markedly enlarged and papillose as usually in the VOLUTINÆ or in the recent *Fulguraria*.

We come now to the variations in form, and in this point of view we are able to distinguish three principal varieties.

Var. a.—The spire is short with an angle of from 55—80 degrees, the posterior portion of the whorls along the suture is concave, the angle below sharp, tuberculated in young specimens in consequence of the elevated terminations of the transverse ribs, (see Figs. 8 and 9), the tubercles disappearing perfectly in full grown specimens and being replaced by a smooth keel (*vide* Fig. 5). This is a very common variety throughout the upper beds of the South Indian cretaceous deposits. Römer's first published figure of this species refers to this variety. (*Vide* Pl. VII, Figs. 4, 5, 7, 8, 9.)

Var. b.—The entire shell is slender, the spire produced, the striæ on the contracted portion of the whorls usually 5-6, and on the last whorl distant transverse ribs sharpened on the keel in young, and indistinctly tuberculated on larger grown, specimens. D'Orbigny's and Zekeli's figures refer to this variety. (*Vide* Pl. VII, Figs. 1 and 2). The *Mitra Murchisoni* of Müller could also belong to this variety.

Var. c.—Shell very much elongated with numerous fine spiral striæ on the contracted portion of the whorls, the other striæ on the last whorl from the first not very thick and usually soon becoming more or less obsolete in more largely grown specimens. Keel more distinct in elder specimens than in smaller, the transverse ribs less except on the keel itself, where they form pointed tuberculations. (*Vide* Pl. VII, Figs. 3, 6.)

Each of these varieties, although not strictly confined to certain localities, may be said to prevail at one or the other. The *Var. a.* is most common at E. of Alundanapuram, W. of Kullgoody and E. of Anapaudy; the *Var. b.* near Koloture and Veraghoor; and the *Var. c.* near Serdamungalum. The species is in general very common throughout the Trichinopoly district, and there are several small specimens of

it in the Madras Museum marked with a new specific name, apparently in Mr. Kaye's or Cunliffe's handwriting. These seem to have been procured subsequently to Prof. Forbes' examination of the fossils, and are probably not from Pondicherry, but from the blueish sandstones near Garudamungalum or Serdamungalum.

Localities.—The above-mentioned are the principal localities within the Trichinopoly group, where it occurs nearly exclusively. There are only a few specimens from South-West of Shutanure, which locality lies, according to Mr. Blanford's map, within the Ootatoor group, but close to the boundary of the Trichinopoly; a few specimens are from the east of Veraghoor and south of Arrialoor out of the Arrialoor group.

Formations.—Principal position in the Trichinopoly-, doubtful in the Ootatoor-, but more common in the Arrialoor-groups.

This species is well known in Europe from the middle cretaceous deposits. It occurs throughout Northern Germany from Eastern Galizia towards Aachen and the Rhine, and is common in the deposits of the Alpine Gosau-formation. D'Orbigny described his specimens from Uchaux, and in his "Prodrome" he places it in the *étage Turonien*. It has not, so far as I am aware, been noticed in England, but a similar species is known to be very common in North America.

2. Fulguraria multistriata, *Stoliczka*. Pl. VIII, Figs. 1—3.

Fulg. testa fusiformi elongata, anfractibus postice prope suturam constrictis, excavatis, infra constrictionem angulatis; ultimo maximo, subventricoso; omninis transversim tuberculate-costatis, costis ad angulum terminantibus, in ultimo ad medium evanescentibus, spiraliter striatis, striis numerosis,—imprimis postice,—prope suturam nonnullis crassioribus; labio calloso, ad medium quadriplicato, plicis anticis crassioribus, obliquioribus atque magis distantibus.

Spiral angle 50°.

This species is proposed for a series of specimens, which in general form agree with the preceding *Fulguraria elongata*, D'Orb. They differ by a larger number of spiral striæ, these being thinner and placed closer to each other, and by having four columellar plaits, instead of three. The anterior of the four is somewhat more distant than the other three among themselves, and is the most oblique. Interiorly all the plaits are comparatively much more oblique than in *Fulg. elongata*, and there is occasionally a thin fifth fold next to the last posterior. The columella is equally flattened internally, but externally apparently not so much angulated, except close to the anterior extremity.

Locality.—E. of Anapaudy; apparently not very common.

Formation.—Trichinopoly-, close to the boundary of the Arrialoor-group.

XVII. ATHLETA, *Conrad*, 1860.

(*Vide* Jour. Acad. Nat. Sc. Phil. 2d. ser. Vol. IV, p. 292, Pl. 46, Fig. 32.)

Conrad gave the above name to a very characteristic fossil, meaning it as a sub-genus of *Volutilithes*, from which, however, the species figured by him differs essentially in having the anterior extremity little produced, scarcely half as much as in the typical *Volutilithes*, the anterior termination being moreover truncate as in *Scapha* or *Voluta*. Gabb (Proc. Am. Phil. Soc. VIII, 1861, p. 150) quotes the species as *Volutilithes leioderma*, Con., without referring to the sub-generic distinction at all. We cannot pronounce any opinion upon the American fossil, but the character noticed by Conrad seems to be not so unimportant. Conrad says, loc. cit. "labrum slightly notched or sinuous at the superior extremity," and further "the suture covered by a deposit as in the genus *Ancilla*." These differences are very marked in two of our cretaceous species. Both margins are united by a callus, producing on the aperture a distinct posterior canal, the end of which is often prolonged in a furrow below the suture, which itself is covered by the callosity of the inner lip. One of the species, the *Vol. purpuriformis*, of Forbes (*Fusus id.* D'Orbigny and others), resembles very much recent species, which are referred by Adams to *Harpula* (remarkably distinct from *Voluta*, (*sensu restricto*) and the other bears much resemblance to *Enæta*, Adams (which ought to be kept distinct from *Lyria* proper, not regarded as a sub-genus only, according to Gray). I am rather sorry that I have none of these living shells to compare with our fossils, but so far as their characteristics or those of other sub-divisions of the VOLUTINÆ have been noticed, they seem not to exhibit these peculiarities, and I should think that if they existed, they could not have been overlooked.

The distinction from *Volutilithes* must certainly be recorded, and it remains only doubtful whether the species can be classed with *Harpula*, Swainson, or in a separate genus.

The character, as deduced from the three cretaceous species known up to the present, may be put thus:

Athl. testa ovate-conica, elongata, spira brevi; ultimo anfractu ventricoso, antice paulum prolongato, truncato atque emarginato; apertura ovali, antice late- postice anguste-effusa, marginibus postice callosis, unitis; callositate suturam tegente; labio antice plicato, postice lævissimo, plicis anterioribus fortioribus, numerosis.

Conrad mentions in *Ath. leioderma* four columellar plaits; one of our species has three and the other five plaits, although there may possibly be found to be one more in each of the two species. The same author refers to *Athleta* the *Voluta Tuomeyi* (ibid Pl. 47, Fig. 35), which belongs to the same group as *Volut. rarispina*, Lam. and others, and which, I rather believe, ought to be classed in a separate genus.

1. Athleta purpuriformis, *Forbes*, sp. Pl. VIII, Figs. 4, 5, 6, 7.

1846. *Voluta purpuriformis*, Forbes, Trans. Geol. Soc. Lond. VII, p. 130, Pl. 12, Fig. 2.
1847. *Fusus ponderosus*, D'Orbigny, Voy. Astrolabe et Zélée, Pal. Pl. 2, Fig. 33.
1850. *Fusus* „ D'Orbigny, Prod. II, p. 229; idem Gabb, Pictet, and others.

Athl. testa ovata; spira brevi, acuminata, apice papillari; anfractibus 5—7, *ad suturam impressis, plus minusve contractis seu lente excavatis, ultimo ventricoso; superficie spiraliter sulcosa, sulcis in ultimo anfractu seniorum speciminum subobsoletis; apertura ovata, postice acuta, subcanaliculata, antice emarginata; canali recto, ad terminationem margine paulum reflexo; plicis columellaribus quinis, anticis maximis.*

Spiral angle 75°—85°; sutural angle 9°.
Height of last whorl : total height of shell (taken as 1·00) ... 0·73—0·80.

Shell elongated ovate, with a pointed spire, consisting usually of six volutions, the uppermost of which are smooth, mamillated, and the succeeding always more or less contracted and consequently excavated along the suture. The last whorl is ventricose, especially in adult specimens, embracing more than two-thirds of the previous whorls and leaving only a comparatively short spire visible. The young shell is all over spirally sulcated, the sulci being all of equal width, except a few near the suture, where they are placed closer to each other. With advancing age the shell becomes more or less covered with an enamel coating, the sulci become broader than the elevated interspaces between them, and gradually disappear totally on the median portion of the whorls.

The aperture is enlarged ovate; the outer lip gradually becomes thinner towards the margin; the inner lip is posteriorly considerably thickened, especially where it unites with the outer lip, forming a slight canal. This callosity, arising from the united margins of the outer and inner lips, covers the lower portions of all the preceding whorls. On perfect specimens only the three anterior folds are slightly perceptible, but a little farther internally I have traced two more, and it is possible that one or two may still be shown to exist in full grown specimens. The anterior folds are the strongest, as in all other *volutinæ*. The canal is pretty long, and although it has not been observed quite perfect, there cannot be a question, that its margin has been somewhat reflexed upwards, and deeply emarginated, in which point this species appears to resemble rather more some of the *Cassididæ* than of the *volutinæ*. D'Orbigny has been certainly misled in placing the species under *Fusus*, because Forbes has neither mentioned nor figured any columellar plaits. D'Orbigny's *Fusus ponderosus*, figured in the Paléontologié of the Astrolabe, can certainly apply only to the same species.

Localities.—Pondicherry; neighbourhood of Kullygoody and between Andoor and Veraghoor; common, but very rare in good preservation. The shell of the specimens from Kullygoody is often covered all over with small round holes, produced by some kind of shell-boring Amorphozoa.

Formation.—(?) Valudayur- and Trichinopoly-groups.

2.—Athleta scrobiculata, *Stoliczka*. Pl. VIII, Fig. 8.

Ath. testa ovata, crassa, spira brevi; anfractibus quinis, prope planis, in medio parum excavatis, sutura impressa canaliculata sejunctis; ultimo anfractu ventricoso; superficie costis spiralibus atque transversalibus fenestrata, scrobiculata; apertura ovate-elongata, postice acute effusa, antice emarginata; labro ad terminationem posteriorem crasse dentato; labio calloso, partem inferiorem ultimi anfractus fere totam tegente, antice triplicato.

Spiral angle 82°; sutural angle 5°.
Height of last whorl : total height (considered as 1·00) ... 0·70.

The shell is composed of only five volutions, the last of which is ventricose, and enveloping the previous one to a great extent. The surface exhibits broad transverse and spiral ribs giving it a coarsely reticulated structure. Below the first sutural rib and the next stronger, there is on the last whorl a large interspace left, which having in the middle only one or two much finer ribs, forms a kind of a broad and shallow sulcus, remaining distinctly marked on all the previous whorls, where only the two ribs bounding the excavation on either side are present. Of the convexity of the last whorl nothing is seen on the upper volutions.

The sutures are deeply impressed, canaliculated. The outer lip is somewhat sharpened on the margin, and is on its posterior termination strongly thickened tooth-like. The inner lip covers the greater part of lower or front portion of the last whorl. Both margins are on the posterior canal united by callosity, and the canal itself remains visible on the entire last whorl, forming a similar narrow impression parallel to the suture and gradually uniting with the latter. There are only three oblique and nearly equal folds visible in our specimen, otherwise the species resembles much *Vol. cassidula*, Reeve (Monog. Volutidæ, 1851, Pl. XXII, Fig. 60) Japan seas.

Locality.—W. of Kullygoody in Trichinopoly; the single as yet known and figured specimen occurred in a soft whitish sandstone.

Formation.—Trichinopoly group. (?)

XVIII. VOLUTILITHES, *Swainson*, 1831.

(*Vide* Adams' Genera I, p. 167; Chenu's Manual I, p. 190, and others.)

It is well known that a large number of fossil tertiary and cretaceous species belongs to this genus, of which a single recent species has been found at a great depth near the Cape of Good Hope. The most striking difference of this genus from other *volutinæ* is the prolongation of the anterior extremity of the shell into a canal, being notched at its termination as in other *volutinæ*. In form, it must be granted, the *Volutilithes* are most nearly related to *Fulguraria*, and strictly speaking only the peculiar form of the inner lip in the latter remains as a characteristic distinction from the former. It was originally intended to establish the new genus only for the recent species and those fossil forms which agree with it in the granular or spinulose and reticulated markings of the shell surface. The palæontologists soon availed

themselves, however, of the opportunity of the new generic distinction, regarding the ornamentation as unimportant and admitting only special reference to the characteristic form of the shell. This is in many cases quite correct, but it is well known, that the kind of ornamentation often carries with it such changes in the character of the shell and thus anticipates the existence of organs, which are often recorded as generic distinctions. There are at least 35 cretaceous species known, which belong to this genus, and the number of tertiary is still larger. It will soon be necessary, if those species come to be properly classified, to direct attention to these and similar distinctions, and to group them in a way similar to what has been already done with the genus *Voluta* itself.

The number of columellar plaits varies in the fossil species usually between two and three, the latter being the most common, but the finer plaits seem to be often obliterate in a fossil state. The gradual and moderate prolongation of the anterior extremity and the shortness of the spire are often the only exterior distinctions which can be noticed between *Volutilithes* and *Fasciolaria*.

1. Volutilithes latisepta, *Stoliczka*. Pl. IX, Figs. 1 and 2.

Vol. testa ovate elongata, spira brevi; anfractibus quinis seu senis, primis lævigatis, ultimo maximo, subinflato, omninis transversim costatis; costis tenuis, 8—10 *in uno circuitu, parum obliquis, ad suturam fere obsoletis, supra medium maxime elevatis, crassioribus atque non-nunquam subtuberculatis, antice in ultimo anfractu obsoletis; superficie striis tenuissimis spiralibus tecta; columella tres plicas perobliquas, tenues exhibente.*

Spiral angle 44°—46°; sutural angle 12°—13°.

This shell in many respects recalls *V. Casparini*, D'Orb., from the European cretaceous deposits (vide Pal. Franç. Pl. 220, Fig. 5, and Sitzungsb. Akad. Wien, 1865, Vol. LII, Revision etc. p. 72) differing from it by a generally smaller number of transverse ribs, shorter spire, but comparatively higher and less numerous whorls, and by having the three columellar folds much more obliquely placed. The embryonal whorls are somewhat enlarged, thickened, convex and smooth. The shell surface, when well preserved, exhibits on the other whorls very close and fine spiral striæ crossed by as many lines of growth, assuming on this account an irregular undulating course. The margin of the outer lip is thickened and smooth; the aperture posteriorly pointed; the inner lip thin. The ribs on the upper whorls are somewhat more numerous than on the last. It is possible that Prof. Forbes meant this species under his *Vol. septemcostata* (l. cit. p. 131, Pl. 12, Fig. 3), but nothing approximately certain can be made out of his figure or description, although this is the only way in which I can offer any signification for the species referred to.

Locality.—N. and S. of Cumalypooram, S. W. of Arrialoor, in Trichinopoly district; does not appear to be a common shell.

Formation.—Arrialoor group.

2. Volutilithes accumulata, *Stoliczka*. Pl. IX, Figs. 3 and 4.

V. testa ovate-elongata, spira brevi, quartam partem totius altitudinis formante; anfractibus senis seu septenis, accumulatis: primis duobus teretibus lævigatis, ultimo supra inflato, antice valde attenuato, omninis convexis, transversim costatis, spiraliter minute striatis; costis 16—18 *in uno circuitu, ad suturas subangulatis; columella ad medium triplicata: plicis obliquis, mediana crassissima.*

Spiral angle 60°—75°; sutural angle about 10°.

The short spire, consisting of about five whorls only, these being strongly convex, the thickness of the posterior and the attenuated prolongation of the anterior portion of the last whorl, farther the numerous transverse ribs, varying from 16 to 18, and the three oblique columellar plaits, of which the middle is the strongest, can serve as the principal distinctions of this species from *Vol. Casparini*, D'Orb. and *Vol. latisepta*, n. sp.

The embryonal whorls are as usual equally smooth, but they are not so high and are much more strongly convex than in *V. latisepta;* the posterior portion of the inner lip appears to be also thicker in the present species. The surface is finely striated spirally and the striæ become coarser with the size of the shell, or rather the impressed lines become more distant and somewhat deeper. The ribs on the upper whorls, next to the smooth embryonal ones, are more numerous, thin and more oblique, while the following are straight or even somewhat bent in the opposite direction (to the right); on the last whorl they are slightly flexuous and disappear soon below the middle of the height.

I am not convinced that this species is not identical with *Vol. d'Orbignyana*, Müller (Petref. Aachner Kreide-form. 1851, II, p. 40, Pl. 5, Fig. 27); in all respects it is most nearly related to it, and differs only by a shorter spire and greater number of columellar plaits. Müller says, that his specimen is "perfectly preserved," and with two columellar plaits only, while our specimens have distinctly three plaits, if the number may not be found to be increased by a fourth posterior one.

Localities.—Near Olapaudy, Andoor, E. of Anapaudy, and S. of Serdamungalum; although not rare, no specimen has yet been found perfect with the outer lip.

Formation.—Trichinopoly group.

3. Volutilithes muricata, *Forbes, sp.* Pl. IX, Fig. 5.

1846. *Voluta muricata*, Forbes, Trans. Geol. Soc. Lond. VII, p. 131, Pl. XII, Fig. 4.
1850. „ *submuricata*, D'Orb., Prod. II, p. 226; idem Gabb, etc.

Vol. testa ovata, antice attenuata, postice apice acuta, inflata, spira brevi; anfractibus paucis, tranversim atque spiraliter costulatis; costulis primis fortioribus, in ultimo anfractu antice evanescentibus; ultimis acutis, supernis crassioribus, duabus prope suturam sulcis latioribus sejunctis, solum in anfractibus superioribus conspicuis; apertura angusta; labio ad medium 4-5 *plicato, plicis anterioribus fortioribus.*

This species has a remarkably short spire with an angle of about 90 degrees, and the last whorl, which becomes anteriorly gradually thinner, measures nearly

three-fourths of the total height. There are about 14 transverse ribs on the last whorl crossed by numerous spiral ribbings, which have posteriorly a sharper margin, so as to follow each other like scales. The two uppermost spiral ribs are stronger and separated from each other and from the lower ones by broader sulcations; the suture presents a tuberculated margin, swollen up and mostly obliterating the prolongations of the transverse ribs; the two spiral ribs are the only ones visible on the upper whorls, where they besides exhibit very fine spiral striæ. The inner lip exposes four or five not very oblique folds, of which the second anterior is the strongest.

Locality.—W. of Kullygoody in whitish soft sandstone; apparently a very rare shell. Forbes described his specimen from Pondicherry, but whether from the Arrialoor or from the Valudayur beds remains to be proved.

Formation.—Trichinopoly group (?).

4. Volutilithes radula, *Sowerby, sp.* Pl. IX, Fig. 6.

1846. *Voluta radula*, Sow. Forbes, Trans. Geol. Soc. Lond. VII, p. 133, Pl. 12, Fig. 9.
idem D'Orbigny, Gabb, Pictet, and others.

Vol. testa elongate-ovata, spira brevi; vix tertiam partem totius altitudinis formante, anfractibus fere planis, ultimo ventricoso, maximo; superficie costulis (18-22) *transversalibus atque sulcis spiralibus fenestrata, anterioribus plus minusve granulosis seu spinulosis; apertura elongata, lateraliter compressa, postice acute angulata, antice late effusa; labro ad marginem undulato; labio tenui, antice ad marginem duabus plicis obliquis ornato; canali longo, supra paulum recurvo.*

Spiral angle 60;° sutural angle 10.°
Height of last whorl : total height of shell (considered as 1·00) ... 0·73

Shell elongated, ovate, consisting of about six nearly plane volutions, of which the last is somewhat ventricose, occupying a little more than two-thirds of the total height. The surface is more or less distinctly granulated. This ornamentation arises, as in other similar species, from the undulating margin of the outer lip, which is somewhat produced and bent outwards. This raised margin is, as the growth of the shell proceeds, retained and forms on the surface transversal tuberculated ribs. It depends then very much upon the state of preservation, whether the transversal or spiral sulci are more or less obliterate, and according to these the tuberculated elevations form more or less distinct transversal or spiral ribbings. When the tubercles are worn off, the surface appears regularly cancellated. In this state the present species is very like the *Vol. nitidula*, Müller (Petref. Aach. Kreideform. 1851 II, p. 41, Pl. 5, Fig. 25), from the cretaceous deposits of Aachen and it is very doubtful, whether this is different at all, as it has only two columellar plaits, like in the Indian form under description. On the upper volutions there remain generally not more than four or five spiral rows of the tubercles exposed, and the uppermost is usually separated from the others by a deeper sulcation. The transverse ribs are on the first three or four volutions slightly developed, while the spiral granulated

striæ appear more strongly marked. The aperture is narrow, pointed posteriorly and broadly emarginated anteriorly; the canal is rather long and bent to the left side (in front view) and somewhat upwards. The inner lip exposes on the margin two oblique plaits only, posteriorly it seems to be so thin that the granular structure of the underlying surface appears quite distinct, although some smaller posterior plaits were probably present. It is even possible that a third thinner plait exists between the two stronger ones. The peculiar bending of the canal leaves the determination of this species as a *Volutilithes* uncertain. There are several species (*V. lima* and *limopsis*) in Europe and North America, which in form and structure of the shell exhibit scarcely any difference from this. Of cretaceous it will be necessary to compare with our Indian fossil well preserved specimens of *V. fenestrata*, Zek. from the Alpine Gosau-formation (vide Abhandlg. der geol. Reichs-Anstalt, Wien, I, p. 73, f. 13, Fig. 6, and Sitzungsb. Akad. Wien. Vol. LII. Revision &c. p. 71).

Locality.—From a blueish and white sandstone near Kullygoody in Trichinopoly district several specimens have been obtained. Forbes states the loc. Pondicherry and notes it as apparently abundant. One specimen from the Madras Museum marked with the same locality agrees in mineralogical character fully with the Kullygoody sandstone. It is probable, however, that the Kullygoody beds are represented near Pondicherry, classed by Blanford in the uppermost group, and that these beds have to be referred rather to the Arrialoor than to the Trichinopoly-group, if on other grounds the distinction between those two groups is either possible and necessary.

Formation.—Trichinopoly group, (?)—according to Mr. Blanford's map.

XIX. LYRIA, *Gray*, 1847.

(*Vide* Adams' Genera I, p. 166, II, p. 616; Chenu's Manual I, p. 190; Crosse in Journal de ser. 3, Vol, VI., p. 105.)

The genus *Lyria* was first established by Gray for those *Mitra*-like *Volutæ* which have a large number of columellar plaits, the two anterior of these being the strongest, and the posterior portion of the inner lip provided with a large number of short cross-plaits or folds. It is a very marked and characteristic genus, which next to *Volutilithes* has the most numerous representatives in eocene rocks; cretaceous species are as yet scarcely known, at least there is a great difficulty in attributing any of those which have been described, to it.

Gray has distinguished, besides *Lyria* (proper), a sub-genus *Harpella* and accepted *Enæta*. *Harpella* ought to differ in having numerous small grooves on the inner lip. The fact appears to be that the interstitiæ of the short posterior plaits are somewhat broader in *Lyr. (Harpella) costata*, Swains, (*lyrata* Humph.), than usual, the plaits themselves being somewhat obsolete. The *Lyr. Delessertiana*, Petit, has this character not nearly so distinct, and it is in fact scarcely possible to give any other generic distinction from *Lyr. mitræformis*, Lam. The genus *Lyria*, as stated by Messrs. Adams in their 'Genera' ought, we believe, to be retained. The distinction of *Enæta*, Adams, would appear more desirable, the respective species being besides characterized

by a strong tooth on the interior margin of about the middle of the outer lip, but if species like *Voluta harpa*, Barnes, are to be transferred to *Lyria*, this character could no longer be of any importance. Most of the species are otherwise well characterized by a thick solid shell, a short spire and usually ribbed whorls; they approach in this respect most nearly to the MITRINÆ.

In a recent paper in the 'Journal de Conchyliologie' (1866. 3 ser., VI. tom. p. 105), Mr. Crosse re-established fully the genus *Lyria*, and recorded all its peculiarities, affinities to, and distinctions from, other allied genera.

One of the most important characters which has been added to those already specified by Dr. Gray and Messrs. H. and A. Adams, was the discovery of a *narrow, elongated and horny operculum* in *Lyria deliciosa*, Montf. and *Lyr. harpa*, Barnes. In a still more recent note (Journ. Conch. 1866, 3me.Ser. VIme. tom. p. 335), Mr. Crosse records the interesting fact, that the operculum of *Lyr. deliciosa* has first nearly a *central* and in more advanced age a *subapical* nucleus. Mr. Crosse draws the very natural conclusion, that most probably all the other species of *Lyria* possess a similar operculum. The author summarises his remarks in the following characteristics of the genus:

"*Testa ovato-oblonga, mitriformis, crassiuscula, plerumque (sed non semper) lon-*
"*gitudinaliter costata; apertura subovata, leviter stricta; margine columellari ad*
"*basim valide biplicato, deinde plicis parviusculis, plus minusve numerosis munito,*
"*interdum ad parietem unidenticulato, margine dextro extus turgido, peculiariter*
"*inflato, ad limbum simplice, acuto.*"

"*Operculum ovato-elongatum, tenuisculum, corneum, supra concentrice sed*
"*inæqualiter rugoso-striatum, circa nucleum dextrorsum nec procul ab apice situm;*
"*subtus annulare.*"

"*Animal ignotum.*"

Mr. Crosse enumerates 14 species of recent *Lyriæ*, three of them, however, are doubtful, namely *Vol. guttata*, Reeve, *V. cylleniformis*, Sow., and *V. Guildingi*, Sow. Should the separation of the genus *Enæta* be found necessary, they have to be transferred to it; the other 11 species are quoted as true *Lyriæ*, among which the *L. mitræformis* and *L. Delessertiana* are probably the best known representatives.

From the cretaceous beds of South India, we have to notice three characteristic species.

1. LYRIA FORMOSA, *Stoliczka*. Pl. IX, Figs. 7 and 8.

Lyr. testa ovate-elongata, utrinque acuta, spira ultimo anfractu breviore; anfractibus parum convexis, transversim costulatis; costulis 14-18 *in uno circuitu, prope rectis, postice ad suturam duobus sulcis spiralibus intercisis; ultimo anfractu antice spiraliter minute-sulcoso; apertura angustissima, antice atque postice acuta; labio multiplicato: plica antica ad marginem canalis maxima, posticis sensim tenuioribus.*

Spiral angle 57°; sutural angle 11°.
Height of last whorl : total height of shell (taken as 1·00) ... ... 0·66.

This species can be readily distinguished by the large number of transverse ribs, which vary from 14 to 18 in one volution and are along the suture crossed by two

successive impressed lines, so as to cause in some respect the formation of two rows of small tubercles. The anterior portion of the last whorl is numerously and finely sulcated. The inner lip exhibits many oblique folds, of which the posterior ones are very thin and only the last anterior is considerably stronger, while in the living species of *Lyria* there are usually two stronger anterior folds. The species, although not rare, does not seem to attain a large size; the usual being 18mm. in height and 8mm. in width on the last whorl; the elongated and on both ends pointed form of the shell being apparently very characteristic.

Locality.—Ninnyoor in Trichinopoly district; occurring in whitish sandy limestone.

Formation.—Arrialoor group.

2. Lyria crassicostata, *Stoliczka.* Pl. IX, Fig. 9.

Lyr. testa elongata, fusiformi; anfractibus subconvexis, costis transversalibus 8—9 *in uno circuitu, crassis, prope rectis, in superficie spiraliter minutissime striatis; ultimo spira vix altiore; apertura valde compressa ac elongata; margine interiori incrassato, plicoso: plicis anterioribus fortioribus, posterioribus brevioribus.*

Spiral angle about 32°; sutural angle 15°.

This is a very peculiar species distinguished by a great thickness of the shell, and although known only from the imperfect specimen figured, it is so very characteristic, that even small fragments could be again recognised from this. The number of whorls amounts to six or seven, each having 8 to 9 transverse, very thick ribs, extending from one suture to the other, being only slightly bent and nearly perpendicular; on the last whorl, which appears to have been somewhat higher than the spire, they are anteriorly recurved and terminate on approaching the inner lip, along which there is a thick swelling, indicating the presence of a strong emargination of the aperture on the anterior extremity. The entire surface is covered with very fine spiral striæ, besides which striæ of growth appear more or less distinctly marked. The aperture is long and narrow, and according to the bending of the canal curved in a similar manner. The outer lip, as well as the anterior termination of the canal, are not perfect in our specimen, but the plication of the inner lip exhibits the characters of this genus pretty well; the inner margin being folded in its entire extent. The folds increase in thickness towards the anterior extremity, the second one being apparently the strongest, the first anterior somewhat less in strength.

Locality.—Comarapolliam (North of Arrialoor) in Trichinopoly district; out of conglomeratic siliceous sandstone.

Formation.—Arrialoor group.

3. Lyria granulosa, *Stoliczka*. Pl. IX, Figs. 10 and 11.

L. testa elongata; anfractibus subconvexis, gradatis, transversaliter acute-, spiraliter late-, costatis: costis transversalibus circiter 15 *in uno circuitu, usque ad suturam extensis, spiralibus in anfractibus superioribus quinis seu senis, in ultimo numerosis, omninis latis, in costis transversalibus subtuberculatis, interstitiis profundis, fere æqualibus separatis; canali sinistrorse lateraliter curvato; labio multiplicato: plicis anterioribus fortioribus, minoribus nonnunquam alternantibus.*

Spiral angle 37°; sutural angle 10°.

The great number of sharp and nearly straight transverse ribs, which extend over the total width of each whorl, show a resemblance in this species to *Volutilithes radula*, from which it is readily distinguished by its more elongated form, the last whorl being nearly of equal height with the spire, while the same greatly exceeds the elevation of the spire in the other species. The spiral ribbings of *Lyr. granulosa* are remarkably broad, not very high, forming moderate tubercles, when crossing the transverse ribs; they vary from 5 to 6 on the upper volutions, and the two posterior or upper ones are placed closer to each other than the rest; an equally marked distinction from *V. radula*, Sow. Towards the anterior extremity the strength of the ribs decreases, and they are here often replaced by alternating rows of smaller and larger tubercles.

Although several specimens have been procured from the whitish sandstones near Koloture, none of them has the aperture perfectly preserved. The length of the canal may be calculated from the fragment on Pl. IX, Fig. 11; it was a little bent to the left side. The inner lip exposes a great number of plaits in its entire length, the anterior ones are strongest, and often alternate on the margin of the aperture with other short plaits; the posterior die out gradually, and, in consequence of the inner lip being thin, the spiral granulated rows of the shell-surface become apparent; this is also clearly visible in the figured fragment (Fig. 11), the columellar margin of which has been exposed for that purpose. According to a small specimen, which shows an original portion of the outer lip, this had a sharp margin, grooved internally as indicated by, though not dependent upon, the spiral ornamentation on the exterior surface.

Localities.—In whitish sandstone near Koloture, and in a similar sandy-limestone between Andoor and Veraghoor, in the Trichinopoly district.

Formation.—(?) Trichinopoly group, both the mentioned localities are, however, close to the uncertain boundary of the Arrialoor group, and the mineralogical character of the rock is the same as that of the typical Arrialoor sandstone from the neighbourhood of Arrialoor, so the species may rather be looked for in the Arrialoor beds, should these remain separated from the Trichinopoly group.

c. *Sub-family—VOLUTOMITRINÆ.*

(*Vide* Gray's Guide, 1857, p. 36; Adams' Genera, II, p. 619.)

XX. VOLUTOMITRA, Gray, 1847.

Gray has separated lately the genus *Volutomitra* in a sub-family of his *VOLUTIDÆ* on the ground of the middle tooth of the lingual membrane being stronger, with a cone-like apex. The shell of *Volutomitra* itself may be said to have as much resemblance to the *VOLUTINÆ* as to the *MITRINÆ*, with the former of which it agrees generally in the smoothness of the shell or at least the want of any stronger transverse ribs, while the columellar plaits are arranged more like to those of the *MITRINÆ*. In so far there appears every reason for supposing, that the differences pointed out by Dr. Gray have a classificatory value, and that the sub-family may stand as indicating a passage from the *VOLUTINÆ* to the *MITRINÆ*, in which case there is by far less reason to separate the latter sub-family altogether from the *VOLUTIDÆ*. The same author says, that the tentacles of *V. Groenlandica* are close at the base, the eyes one-third above the base (but on large tubercles!) and the siphon simple, which evidently agrees much more with other *MITRINÆ* than with the *VOLUTINÆ*.

There are several fossil tertiary species, which belong to this group. None of the *MITRINÆ* described from cretaceous rocks exhibits, however, the characters of the genus, and the species, which we here refer to it, may be said to agree only *exteriorly* with it, as we have not been able to procure a quite perfect specimen.

1. VOLUTOMITRA CANALICULATA, *Stoliczka*. Pl. IX, Figs. 12 and 13.

Vol. testa ovate-elongata; anfractibus quinis, convexis, prope suturam canaliculatis, spiraliter numerosissime atque minute-sulcatis, seu striatis: striis in medio ultimi anfractus subobsoletis; apertura angusta, elongata, antice atque postice subacuta; canali lateraliter curvato, prolongato; labio triplicato, plica antica tenui, duobus posterioribus crassioribus, fere æqualibus.

Spiral angle 60°; sutural angle 10°.
Height of last whorl : total of shell (considered as 1·00°) ... ... 0·63.

An ovately elongated shell composed of about five convex volutions, the last exceeding the spire in height. Below the suture there is a distinct broad furrow on all whorls, the margin of the suture itself being marked by an elevated line, and a similar line is distinguished on the last whorl below the furrow, being bounded on either side by an impression. All the other surface of the shell is densely covered with fine spiral striæ and sulci respectively, both becoming usually obsolete on the middle of the last whorl and also partially so on the upper volutions of the spire. The aperture is much elongated, being laterally compressed and pointed on each end. The canal is produced and bent a little to the left side (in front view), and more so than usually in living species of the same genus. There are three folds on the inner lip, the two posterior stronger and about equal, the anterior somewhat thinner

It is, however, possible, that a fourth small anterior plait might exist, our specimen being in this respect not quite perfect.

Locality.—Near Serdamungalum, in a blueish calcareous sandstone, apparently rare.

Formation.—Trichinopoly group.

d. *Sub-family—MITRINÆ.*

MITRANA, Gray's Guide, 1857, p. 29.

The animals of the *MITRINÆ*, so far as known, differ in many respects from those of the *VOLUTINÆ*. The foot is triangular, moderately expanded, the siphon long, without any auricles, the tentacles long, bearing the eyes near the basis, but usually within their length. The teeth are in three series, the central of which are broad and denticulated, but exhibiting great variations. It appears, that from a middle central tooth, resembling in all respects that of the *VOLUTOMITRINÆ* and *SCAPHELLINÆ* of Gray, furnished on each side with very small denticles (*Mitra adusta*), a gradual change can be traced to a broad many-denticulated central tooth, so that through the two above-mentioned sub-families the *MITRINÆ* seem in this respect also to be more (or at least quite as much) allied to the *VOLUTINÆ* than to the *FASCIOLARIDÆ*. With the latter family they have been classed by Gray, while H. and A. Adams unite them with the *COLUMBELLIDÆ* in one family. We prefer the older classification in the family *VOLUTIDÆ* to any of these, because the shell has through its consistency and shortness of the canal absolutely much more relation to other *VOLUTIDÆ* than to any *FASCIOLARIDÆ*, and as on the other hand the *COLUMBELLIDÆ* have strictly no columellar plaits, but a *plicated margin* of the aperture only.

None of the *MITRINÆ* are as yet known to have an operculum, like the larger number of the *VOLUTIDÆ*, while the *FASCIOLARIDÆ* have an ovate lamellar operculum much like the *FUSINÆ*, to the shells of which they present certainly the greatest relationship.

I have already noticed, that even with the separation of the *VOLUTOMITRINÆ*, many shells of the *MITRINÆ* are in no other way separable from the *VOLUTINÆ*, except in having the uppermost plaits the strongest and the anterior gradually smaller and thinner. There are indeed only a few exceptions to prevent this distinction being made quite practicable, and to cause other characters to be considered more conclusive, as, for instance, some species of *Cylindra*, Shum. and even *Zierliana*, Gray.

That a distinction of the *MITRINÆ* into several genera is quite as necessary as that of the *VOLUTINÆ*, must be certainly acknowledged in considering such characteristic forms as *Scabricola*, Swains., *Turricula*, Klein, *Zierliana*, Gray and others, but the number of the restricted, or so called, sub-genera is by no means settled. We agree fully with Chenu, when he considers the genera and sub-genera of Swainson, H. and A. Adams and Gray as of equal value, and with probably few exceptions they seem to be so in reality, so that such a desirable separation and classification ought to be at

once carried out in practice. No smaller number would probably allow of a classification of the fossil species, which in neogene and eocene beds are very numerous. Some new types will also have to be added.

The cretaceous representatives are comparatively few, and many of them very doubtful as belonging to this sub-family in consequence of their bad preservation. The following species have to be transferred to *Turricula: Mitra cancellata*, Sow. (*id.* et *M. Cassisiana* D'Orb.); *M. clathrata, Reuss*, (much resembling the new species here described as *Turricula Arrialoorensis)*; *M. Rœmeri*, D'Orb.; *M. Leopoliensis*, Alth; *M. nana*, Müll.; *M. Voitii*, Binkh.: to *Imbricaria* (*Conohelix*, Swains.) probably belong *Mitra conoidea*, Math. and *M. Limburgensis*, Binkh. and it is, as I stated on p. 73, not certain whether this genus, and perhaps *Cylindra* too, ought not to form with *Gosavia* a separate sub-family in the *Conidæ*. The *M. Cenomanensis* and *gracilis*, Guer., and *M. Requieni* and *Vignyensis*, D'Orb. I have not been able to trace. If these prove correct, and the *Mitra cretacea*, Gabb (Pal. Calif. I, 1864, p. 102, Pl. 28, Fig. 215) with the two Indian species be included, the number of known *mitrinæ* will be at the present not more than fifteen. This small number, as compared with the great variety and richness of the recent fauna, is very remarkable.

Pictet quotes 19 species of *Mitra*, excluding the two Indian and one American (Mat. p. l. Pal. Suisse, 1864, 3me Ser. II, pt. p. 682-684). Of these 19 species the following have however to be most probably excluded: *Mit. Murchisoni* and *pyruliformis*, Müller as *Fulguraria* and *Ficulopsis* of the *volutinæ* respectively; *M. Cassisiana*, D'Orb. as not different from *M. cancellata*, Sow.; *Mitra reticulata*, D'Orb. = *Cerith. reticulatum*, Rœmer, Pictet and others. Mr. Rœmer does not mention anything about columellar plaits, and the species must be retained for the present as a *Cerithium*, although it might belong to *Chemnitzia* or *Turbonilla*. Of *Mit. Zekelii, nitida* and *spinosa* from the Alpine Gosau deposits the first two have, I believe, to be retained under *Fasciolaria* and the third as *Borsonia*, as stated in my Revision of the Gosau-gastropoda, p. 87 (Sitz. Akad. Wien, 1865, LII.)

I have quoted the *Fasc. gracilis*, Zek. (*Mitra Zekelii*) Pict. et Camp., as a *Mitra* (loc. cit. p. 79), but having examined some very similar forms from South India, I am rather convinced that the species is better placed in the genus *Fasciolaria*, as the insinuations of the ribs correspond with a similar notch of the outer lip, which is quite foreign to any known species of the *mitrinæ*. Besides this the shell is much thinner and the canal evidently longer, than even in *Turricula cancellata*, Sow. sp. and others. The *Mitra nitida*, Pictet and Camp.=*Fasciolaria nitida*, Zek. is identical with the original *Fasciolaria elongata*, Sow. (*Vide* my Revision. loc. cit. p. 84). One or two new species occur in the Alpine Gosau deposits, but they have not yet been described.

XXI. MITREOLA, *Swainson*, 1840.

(*Vide* Adams' Genera, I, p. 174.-Chenu's Manual, I, p. 194).

The recent species of this genus are through their thickened form of shell, occasionally obsolete transverse ribbings and specially through the papillar structure of the apex, closely allied to the *VOLUTINÆ*; and as the outer lip is sometimes thickened internally about the middle of its extent, it is difficult to distinguish them from *Enæta* by any other character than the stronger posterior plaits of the inner lip.

We refer to this genus the *Voluta citharina* of Forbes on the ground of the last-named characteristic of the columellar plaits.

1. MITREOLA CITHARINA, *Forbes, sp.* Pl. IX, Fig. 14.

1846. *Voluta citharina*, Forbes, Trans. Geol. Soc., Lond. VII, p. 132, Pl. 12, Fig. 8.
idem, D'Orbigny, Gabb, Pictet, etc.

Mit. testa subfusiformi, ovata, ultimo anfractu spira in altitudine vix longiore; anfractibus subconvexis, ad suturam subangulatis, transversim multicostulatis, spiraliter striatis, costulis prope rectis acutisque, una stria prope suturam fortiore atque sulco lato ceteris sejuncta; labio antice quadriplicato.

Spiral angle 45°; sutural angle 7°.

Besides the elongated ovate form of the shell, the spire being about or very nearly as high as the last whorl, the principal character of this species lies in the ornamentation. There being between 18 and 20 transverse ribs present, slightly curved, sharp, crossed by numerous spiral, flat striæ of equal strength on the ribs as well as in the furrows separating them. On the posterior margin of each whorl next to the suture there is a slight swelling and to this follows one of the striæ markedly stronger than all others, and bounded on each side by somewhat broader sulcations; this produces a slight edge near the suture. The aperture is very narrow; the inner lip exposes anteriorly four distinctly oblique folds, placed closely to each other and gradually becoming thinner towards the anterior canal. This last character combined with the total form of the massive shell induces us to place the species rather under the *MITRINÆ* than in the *VOLUTINÆ*, where it has up to this been classed. We have seen only fragmentary specimens belonging to the Madras Museum; they are in a blueish calcareous sandstone, such as the mineralogical character of the Pondicherry fossils usually exhibits.

Locality.—Pondicherry.

Formation.—Valudayur or Arrialoor group. (?)

XXII. TURRICULA, *Klein*, 1753.

(*Vide* Adams' Gen. I, p. 175, Chenu's Man. I, p. 194.)

This genus ought to be restricted for *fusiform shells with a much produced anterior canal* only, in which character they stand next to the *Fasciolaridæ*. The number of plaits varies from three to five.

It would probably be better to form a new generic group for those cretaceous species, of which *Mitra cancellata*, Sow. (*id.* D'Orb., Binkh. a. o.) *Mit. Vaelii*, Binkhorst (Monog. pl. V,[a 3], fig. C,), the here noted South Indian, and other forms may be considered the types. They differ from the great number of species of *Turricula* by a more produced and attenuated canal; but as the margin of the outer lip has not been in any of those species traced perfect with full certainty, and as through the loss of this the above-mentioned difference becomes undoubtedly more exposed, it may for the present not be advisable to anticipate that distinction.

Most of the cretaceous species described as *Mitra* belong to this generic group.

1. Turricula arrialoorensis, *Stoliczka*. Pl. IX, Figs. 15 and 16.

Turr. testa fusiformi; anfractibus prope planis, transversaliter costulatis, spiraliter striatis; costulis 14-20 *in uno circuitu, parum curvatis, in superioribus nonnunquam obsoletis; striis planis, latioribus atque angustioribus alternantibus; apertura angustissima; canali antico moderate longo, attenuato; labio quadriplicato.*

Spiral angle 32°—35°; sutural angle 9°.

The whorls are nearly flat and ornamented with from 14 to 20 transverse ribs, which are slightly curved on the last whorl, the upper portion of each rib—remaining visible on the upper whorls—being straight or even bent in the opposite (to the right) direction. Numerous spiral striæ and sulcations respectively cover the surface, they are generally alternating, unequal in width, but on the transverse ribs very slightly marked. The finer ornamentation of the shell varies a great deal and seems to depend very much on the state of preservation. Occasionally specimens are met with, which have a larger number of transverse ribs, in which case they usually become quite obsolete on the uppermost whorls. When in addition the spiral striation is a little more sharp, such specimens have then a great resemblance to *M. cancellata*, Sow.,* but I have never observed any granulation on the surface of the Indian shell, and even when the ribs are sometimes more numerous than is shown in the figured specimens, the spiral striæ remain apparently always faintly marked. The anterior portion of the canal is prolonged and rather thin, as in *M. cancellata*; the inner lip has four oblique folds, the anterior ones being thinner.

Locality.—Near Comarapolliam in Trichinopoly district.

Formation.—Arrialoor group.

* D'Orbigny separates (Prod. II, p. 154) the *M. cancellata*, Sow. of the Pal. franç. as distinct, under the name of *M. Cassisiana*, evidently on account of there being only three folds represented in the figure of the French species. It is possible that he is right, but certainly it would be a singular case of a *Mitra*, if his specimen had no other fold on the whole space between the three folds marked and the termination of the canal. D'Orbigny's specimen as figured exhibits otherwise no distinctions from the Gosau species, and I believe they are identical.

IX. *Family—FASCIOLARIIDÆ.*

It would be desirable, we believe, to unite the usually so-called *Fasciolariidæ* and *Turbinellidæ* (with the exclusion of the *mitrinæ*) into one family, and to distinguish them as sub-families only. The shells are generally easily separable from those of the *Volutidæ* by the length of the canal, although strict limits can scarcely be drawn. The animals of both are, however, very like, but at the same time considerably different from those of the *Volutidæ*.

The head is never very distinctly separated from the body; the tentacles are subulate, of moderate length, with the eyes on bulgings within their length, that is the eyepedicles are united with the tentacles for some distance; the teeth are on a lingual membrane in three series, the middle ones appear to be usually with three denticles; the lateral with numerous denticles in the *fasciolariinæ* and single in the *turbinellinæ*; the foot is moderately expanded with folded margins, and bears always an ovate lamellar operculum with an apical nucleus.

a. *Sub-family—TURBINELLINÆ.*

(Vasidæ, Adams; Turbinellidæ, Gray, Chenu and others.)

It cannot be questioned that the shells of this group, as restricted by later conchologists, are easily distinguished from those of the next, the columellar plaits being in the middle of the columellar lip, usually very strong, and not very oblique, the shell itself consistent, thick, and not uncommonly covered partially with an enamel coating. The two principal genera, best known as *Turbinella (Turbinellus* or *Mazza)* and *Scolymus (Vasum, Cynodona* or *Cynodonta)* are very marked, the first actually agreeing much more with the *Volutidæ* than with any other *Fasciolariidæ*, although the examination of the animals leaves no doubt as to their difference. When we compare, however, the species of *Leucozonia* of the *fasciolariinæ*, we find that the shell is in its consistency much more of the character of the *turbinellinæ* than of the *fasciolariinæ*, and that some of the species, very similar among themselves, have the plaits less oblique and of nearly equal strength, while in others they are placed exactly in a manner similar to that in typical *Fasciolaria*. For this reason only we would propose to treat these two usually called families under one name, because they certainly do not exhibit a greater difference than for instance do the *mitrinæ* and *volutinæ*, or the *fusinæ* and *muricinæ*, being respectively parts of the families *Volutidæ* and *Muricidæ*.

There are very few fossil species known, which belong to the *turbinellinæ*, as restricted. Most of the tertiary *Turbinellæ* belong to *Latirus* and *Leucozonia*. It is possible that some of the eocene *Volutæ*, as *V. muricina* and others, have more relation to *Scolymus*, than they certainly have to *Volutilithes* or other positively known *Volutidæ*, but the means of ascertaining such a point in fossil species are soon exhausted. The cretaceous number is still a smaller one. Binkhorst (Monog. Gast. et Ceph. Limbg, 1861, pp. 65 and 66), described *Turbinella supracretacea* and *plicata*, two forms very like each other, and which, if farther researches prove

them to be corrrectly determined, must be classed in this group. There is a little discrepancy, I believe, between Binkhorst's figures, which requires explanation. The two species are known from impressions and casts only, but in the Fig. 9b, Pl. V^{a3} of *T. plicata* the spiral striæ show such a direction as could be explained only by a pressure of the specimen, which, however, is not apparent in the figure. The upper volutions of the two *Turbinellæ* and of *Imbricaria Limburgensis*, Binkhst. (*loc. cit.* Pl. II, Fig. 8,) are exceedingly like, while the outline of the outer-lip in the last species does not show that form at all, although it appears to be otherwise perfect. I notice these points merely as doubts arising from the inspection of the figures, but I had never an opportunity of seeing any of these valuable specimens, and apparent identity may be in reality great distinction. There is unquestionably much to be anticipated from well preserved specimens.

Gabb described two cast-specimens as *Turb. subconica and parva* (Proceed. Acad. Nat. sc. Phil. for 1860, publ. 1861, p. 94, Pl. 2, Figs. 6 and 3) from New Jersey; but the specimens being far from perfect even as casts, it is difficult to form an opinion about them.

b. *Sub-family—FASCIOLARIINÆ.*

The principal character of this sub-family lies in the disposition of the columellar plaits, these being present only on the fore-part of the inner lip along the canal, and the anterior plait being usually the strongest. There are only very few, and these only partial, exceptions to be met with in one or two species of *Leucozonia*, where the middle plaits are stronger and those along the canal somewhat thinner.

The shells exhibit great variety in shape, from shortly-ovate to elongated-fusiform, but the canal is always considerably produced. There seems to be at the present no great necessity for establishing more genera than stated by Gray (Guide, 1857, p. 28), namely *Fasciolaria*, *Latirus* and *Leucozonia*. I do not, however, consider the question as to their classification in the *Fasciolariinæ* at all settled. It appears doubtful whether it would not be better to separate *Leucozonia* and a few species of *Latirus* and *Fasciolaria*, marked by a great thickness of the shell, into a separate sub-family, and those with a thin shell, most nearly resembling *Fusus*, into another sub-family. I am only little acquainted with the numerous living species, but nearly all the fossil forms belong to the group with a thin shell. In this latter group very similar generic or sub-generic separations could be made as among the *Fusinæ*.

Adams and accordingly also Chenu, classed *Tudicla*, Bolt., *Busycon*, Bolt. and *Fastigiella*, Reeve, in this sub-family. It appears that *Tudicla* belongs rather to the *Purpuridæ* next to *Rapa*; *Busycon* was subsequently transferred by Adams (Genera, II, p. 655) to the *Fusinæ* and *Fastigiella* to the *Cerithiidæ*. This classification is no doubt more correct. There are several tertiary species, known as *Cerithium*, which must then be classed under *Fastigiella*, although, in having a slight insinuosity on the lower portion of the outer lip, they recall very much *Phos*, Montft.; and it appears not quite certain, whether these two ought not to form a separate sub-family in the *Buccinidæ*. Scarcely any Jurassic species of *Fasciolariinæ* are known. Piette mentions (Bull. Soc. Géol. France, 1856, XIII, p. 593, Pl. XV, Figs. 15 and 16)

a *Fasc. nuda* from the great Oolite of Eparcy; the figured specimen is rather imperfect, but approaches in form to a young *Fasciolaria*. D'Orbigny names in Prod. II., p. 291, from his *étage danien*, two species *F. prima* and *supracretacea*; both these species are in every other respect unknown.

Gabb described in Journ. Nat. sc. Phil. 2d. ser. iv, p. 390, Pl. 68, Fig. 6, a *Fasc. Saffordi* from Tennessee, and *? Fasc. læviuscula*, *? Fasc. Io*, *Fasc. sinuata* from the cretaceous beds of California (Pal. I, 1864, pp. 100 and 101.) Neither of the species are so far perfect that it could be ascertained whether they belong to *Latirus* or *Fasciolaria*, but the form (except in the second-named) agrees rather with that of *Latirus*.

In my revision of the Gastropoda of the Gosau formation (Sitz. Akad. Wien, 1865, LII, p. 84) I have mentioned *Fasc. elongata*, Sow. *(Fasc. nitida*, Zek.*) Fasc. torquilla*, Zek. and *Fas. baccata*, Zek., the last of these must be certainly referred to *Latirus*, but I have not seen sufficiently perfect specimens of the two others. The *Mitra Zekelii*, Pict. et Camp. (*ibid.* p. 79. *Fasc. gracilis*, Zek.) must be retained as *Fasciolaria*. To this number of ten species already known we have to add from the South Indian cretaceous rocks four, *Lat. Reussianus*, *Fasc. carnatica*, *rigida*, (Baily sp.) and *assimilis*.

Other species which have been described under *Fasciolaria* must be excluded and will be found noted in the other groups.

XXII. LATIRUS, *Montfort*, 1810.

(Adams' Gen. I, p. 152; Chenu's Man. p. 181; Gray's Guide, 1857, p. 29).

The short canal, strong transverse ribbings, resembling the varices of the *Tritonidæ*, and the spiral elevated striæ or waved lines unite a large number of species, which form in a certain way a transition from *Leucozonia* to *Fasciolaria*. The columella is usually fissured, but in the process of growth the fissure is filled with the callosity of the inner lip, and in rare cases only it remains open. The columellar plaits are always very faint and in young specimens scarcely traceable. Adams separates *Peristernia*, Mörch, as a distinct genus, but the characters of distinction which he gives cannot be retained. I believe, however, that several of the species, which he refers to that genus, as *F. crenulata*, *gemmata* of Reeve, and others, having exteriorly a more thickened outer and a grooved, but not plicated, inner-lip, belong to *Hindsia* of the *Tritonidæ*.

1. Latirus Reussianus, *Stoliczka*, Pl. X, Figs. 1—4.

Lat. testa fusiformi; anfractibus senis—octonis, ad suturam impressis, transversim costulatis, spiraliter striatis: costis denis seu duodenis in uno circuitu, ad marginem posteriorem subobsoletis, striis plus minusve lamellosis seu crenulatis; apertura ovate-elongata, antice-angustata; labro in margine acuto, intus sulcoso; labio calloso, tenui, obsoleté triplicato; columella antice fissurata, ad terminationem paululum recurva.

Spiral angle 46°—50°; sutural angle 8°.
Height of last whorl : total of shell (consd. as 1·00) ... ... 0·52—0·56.

This species resembles so much *Fusus Reussii*, Zek. (Gosau Gastrop. Wien, 1852 p. 86, Pl. 15, Fig. 11, and Sitzb. Akad. Wien, 1865, LII, Rev. etc. p. 81), that their

identity may be proved in time. I never had occasion to observe any columellar plaits on the Gosau-species, but they may have been only obliterate and not visible from the want of a satisfactory state of preservation. In the present Indian species, the folds are so faint, that in scarcely one out of ten cases are they distinctly marked, and as all the rest regarding form and ornamentation of shell agrees well with the above-mentioned species, it is certainly desirable to draw attention to this point in any future examination. I am at present in doubt whether such faint plaits do not exist in the Gosau species described by Zekeli (*ibid.* p. 74, Pl. 13, Fig. 8) as *Voluta torosa* and transferred by me to *Fusus* (Sitzb. 1865, LII. p. 83); if this be the case, all the three forms must be united under one name. It is even questionable whether the *Fasciolaria torquilla*, Zek. sp. (*Cancellaria id.* Zekeli, loc. cit. p. 81, Pl. 14, Fig. 11) could be kept as distinct; but it has the folds much stronger. The transverse ribs of the present species become above towards the suture of each whorl nearly obsolete, which is specially due to a greater or lesser contraction of the whorls. The spiral striæ are originally pretty strong, numerous and very close; they are crossed by numerous fine lamellar striæ of growth, which occasionally produce a fine granulation on the former.

The outer lip is sharp, and on the margin internally grooved; the inner lip always leaves a small fissure visible near the termination of the columella; close to the posterior end it is only slightly toothed.

Localities.—North of Alundanapooram, Andoor, and E. of Anapaudy, in Trichinopoly district; not rare.

Formation.—Trichinopoly group.

XXIV. FASCIOLARIA, *Lamarck*, 1792.

(Adams' Genera, I, p. 150; Gray's Guide, 1857, p. 28; Chenu's Manual, I. p. 180.)

1. Fasciolaria carnatica, *Stoliczka*, Pl. X, Figs. 8 and 9.

Fasc. testa fusiformi; anfractibus convexis, ultimo spira longiore, spiraliter minute sulcatis, transversim striato-costulatis; costulis supra prope rectis, in ultimo anfractu parum S-forme curvatis atque prope aperturam evanescentibus; canali ad terminationem paulum incurvo; columella triplicata.

Spiral angle 40°; sutural angle 17·5°.
Height of penultimate whorl : that of the spire (consd. as 1·00) ... 0·37.
Height of last whorl : total of shell (consd. as 1·00) ... ... 0·74.

The whorls, usually about six in number, are regularly convex, broadest in the middle, the last considerably longer than the spire. The surface is covered with numerous spiral striæ, and transversal ribs. Of the latter there are from 16 to 20 in one whorl, nearly straight and equal in their entire extent, not tuberculated at the suture, as in *Fas. assimilis*, n. sp. While the spiral striæ increase in strength with age, the transverse ribs disappear gradually altogether, being at first less numerous. The canal is at its termination slightly bent inwards, and the columella exhibits

three folds, the lowest of which is the strongest. As regards general form and character of the ornamentation, this species much resembles *Pleurotoma fenestrata*, Zek. (Gastrop. Gosaugebild. 1852, Pl. 16, Fig. 9), of which I have stated in my revision (Sitzungsb. Akad. Wien, LII, p. 87), that the single specimen figured by Zekeli does not admit of certain generic determination, the surface being quite eroded and disfigured. I do not think it impossible, that these too may prove to be identical.

Localities.—Olapaudy, and neighbourhood of Karapaudy; the species appears to be rather a rare shell.

Formation.—Arrialoor group.

2. Fasciolaria rigida, *Baily, sp.* Pl. X, Figs. 10—16.

1855. *Voluta rigida*, Baily, Quar. Jour. Geol. Soc. Lond. XI, p. 459, Pl. 12, Fig. 4.

Fasc. testa fusiformi, elongata; anfractibus numerosis, scalariformibus, postice valde contractis, ad marginem suturalem tumescentibus ac plus minusve crenulatis, infra crasse-costatis: costis ad angulum nonnunquam subtuberculatis, paulo obliquis, in ultimo anfractu antice obsoletis; superficie spiraliter dense-striata: striis in excavatione posteriori anfractuum tenuioribus; columella 4—5 plicata, plica anteriori crassissima, superioribus sensim tenuioribus, posticis aliquantisper fere obsoletis; canali prope recto, prolongato.

Spiral angle 45°—50°; sutural angle 10°.
Height of last whorl : total of shell (consd. as 1·00) ... ... 0·54—0·60.

The shell of this species is subject to a little variation as regards the length of the spire, this being more or less short than the last whorl, as may be seen by a comparison of the several figures given on Pl. X. The spiral striæ are very numerous, coarse and nearly all of equal strength, except those below the suture on the excavated portion of the shell, where they are usually somewhat thinner. The margin along the suture is always thick, swollen up and more or less crenulated or even tuberculated. The transverse ribs are either very slightly bent or they are straight and become obsolete posteriorly on all, and anteriorly on the last, whorl. There are, however, not unusually cases to be met with, where the spiral striation on the surface of the shell is much worn off, and in such cases the transverse ribs can be traced extending nearly up to the suture. The outer lip is sharp, internally grooved; the inner lip exposes four or five oblique plaits, the posterior one or two being very fine, but not always traceable; the anterior, next to the canal, is always the strongest.

Although the existence of plaits on the columella would make the identity of this species with *Voluta cincta*, Forbes, more probable, than that of *Hemifusus cinctus* n. sp. (described on p. 114) with the same, the total want of any thinner spiral striæ between the principal ones and the elongated spire are rather opposed to this. The question of identity ought, however, not to be given up on this account, but it can scarcely be settled in any other way than by a comparison of Forbes' originals. Baily's figure of *Vol. rigida* represents a specimen apparently with shorter

spire, about equal to one of ours represented in Fig. 18 on Pl. X, but it does not exhibit the slightest difference in the ornamentation, for which reason I believe it to be identical. Baily says, that the columellar plaits were not visible in the specimens, which he examined, and this would be the only point in which a difference could be expected.

This species is very common in the Trichinopoly district, and the largest specimens procured attain a height of 100mm. The following are the principal:—

Localities.—Andoor, Coonum, Shutanure, Anapaudy, Alundanapooram and Serdamungalum.

Formation.—Trichinopoly group.

3. Fasciolaria assimilis, *Stoliczka*. Pl. X, Figs. 5—7.

Fasc. testa fusiformi, attenuata; anfractibus ad medium convexis, infra suturam constrictis, spiraliter dense striatis, transversim costulatis: costulis ad suturam subtuberculatis seu tumescentibus, supra ad medium sinuose-incurvatis; ultimo anfractu spira longiore, antice canali longo extenso; columella ternis plicis obliquis atque crassis ornata.

Spiral angle 30°; sutural angle 16°.	
Height of last whorl : total height of shell (taken as 1·00)	... 0·54.
Height of penultimate whorl : height of spire (consd. as 1·00)	... 0·35.

This species is very well characterised by its much elongated form, great height of the single whorls, the numerous fine spiral striæ and the transversal ribs, which at the suture often terminate in small tubercles, and below the constriction of the whorls are strongly bent inwards. This curvation of the ribs corresponds with a similar shallow notch on the outer margin of the aperture. On young specimens the transverse ribs become occasionally nearly obsolete on the last whorl. The largest specimen from Olapaudy measures 140mm., and some fragments would indicate even a greater height, they have then a tolerably strongly developed keel at the place, where the ribs are insinuated, forming blunt tuberculations. This species resembles much *Mitra Zekelii*, Pict et. Camp. (*Fasciolaria gracilis*, Zekeli, Gastropoden der Gosaugebilde, Wien, 1852, p. 93, Pl. 16, Fig. 12; Stoliczka in Sitzungs. Akad. Wien, LII, p. 79); but as this is known from very imperfect specimens only, I do not think it safe to identify our fossil with it. The transverse ribs seem to be in the Gosau species bent nearer to the middle of the whorls, which appear to be also somewhat thinner; no spiral striation has been observed, although it no doubt exists.

Localities.—Olapaudy, Comarapolliam, S. W. of Mulloor, Karapaudy; not very common.

Formation.—Arrialoor group.

X. *Family—MURICIDÆ.*

(Adams' Genera, I, p. 70; Chenu's Manual, I, p. 133).

The animals of the *Muricidæ* have the head always somewhat lengthened, not thickened, truncate in front; tentacles moderate with united eyepedicles near the base; teeth in three series, the central fixed, usually three-lobed, the lateral versatile, single or at least not numerously hooked; the foot is moderate, never much expanded; the mantle enclosed with an anterior siphon, which is never much produced beyond the length of the canal of the shell.

Operculum annular, horny, ovate with an apical or subapical nucleus; (not known in *Hemifusus*).

The shell is *spiral, ovate or fusiform, usually ornamented with transverse varicose ribs and anteriorly produced into a more or less elongated canal, being notched at the end.* The remainders of the outer lip, forming transversal varix-like ribs, are characteristic for most species and genera, there are, however, a few as *Clavella*, *Neptunea* and others, where the varices become nearly or are actually quite obsolete, although the preponderance of the other characters does not allow us to exclude these forms. It is well known that the exterior ornamentation varies much according to the localities in which the species live, and this can therefore be regarded always only as a quotation of a large sum of distinctive characters. A general description of the shells must necessarily be very extensive, and we prefer, therefore, to attach it to the sub-families, of which the following have been proposed partially by previous authors; *fulgurinæ, fusinæ* and *muricinæ.*

Dr. Gray (Guide, 1857) adds to the *Muricidæ* the sub-divisions *Pisaniana*, *Cominellina* (= *Columbellidæ* in parte), *Nassina* and *Phosina*, the two former of which may undoubtedly be better treated as a separate family, and the two latter in the family *Buccinidæ.* On the other hand Gray separates the species of *Hemifusus*, *Fulgur*, and others into a distinct family, which he calls *Cassidulidæ*; but there seems to be scarcely necessity for such a thorough separation, that of a sub-family is quite sufficient.

Münster (Beitræge etc. 1841) figures (Pl. IX. Fig. 38) a *Fusus Orbignyanus* from the triassic beds of St. Cassian and in an abstract of Dr.Laube's "Fauna of the St. Cassian beds" in the Sitzb. Akad. Wien, Vol. LIII, this fossil has been retained under the same name. The species is not a *Fusus* in the restricted sense of the genus, but not having had an opportunity to examine the species, we cannot of course say whether it does or not belong to the *Fusinæ.* The three other species described and figured by Count Münster (*ibid*, p. 123) are much less *Fusus*, and do not even belong to the family *Muricidæ* at all. There are a number of jurassic species grouped with *Fusus*, but none of the species as yet found is so far perfect as to determine even the sub-family with the requisite accuracy. Deshayes suspects, that all the jurassic and older *Fusus* are only mistaken *Rostellariæ (Alata)*, and for several species this has been already proved to be actually the case; so we may expect some farther alterations. There is, however,

no reason that jurassic forms, like *Fusus Pietti*, Heb. and Desl. (Bull. Soc. Linné. Norm. 1860, V, p. 172, Pl. VIII, Fig. 6), could not belong to the *FUSINÆ*, although it is certainly necessary to examine the specimens strictly and compare with the top whorls of the *ALATA*, which occur with them.

Of cretaceous species about one hundred are known, possibly a few more; they range from the lower Neocomien into the uppermost beds of the chalk. Many of them are true *Fusus*, others belong only to the sub-family *FUSINÆ* and partly to that of the *FULGURINÆ*, but for the larger number of species we are still in great want of well preserved specimens, and, until these have been procured, many doubtful points cannot be settled. Most of the cretaceous species, which were known up to 1864, are catalogued by Pictet in his Materiaux p. l. Paléontologie Suisse, 3me. ser., p. 642, although of many of them (as I shall more particularly notice hereafter) we know in reality nothing more than the mere name.

a. *Sub-family—FULGURINÆ.*

(*CASSIDULIDÆ*, Gray, Guide, 1857, p. 10.)

We propose this name for the sub-family, simply because it is the least liable to be mistaken with any of those previously adopted. Three genera can be distinguished in this group, *Melongena*, Shum. 1817 (*Cassidulus* of Adams and Gray, the name not being traceable with certainty); *Fulgur*, Montf. 1810 (*Busycon* of Adams and Chenu, a name which is equally not traceable), and *Hemifusus*, Swains. (*Cochlidium*, Gray). H. & A. Adams consider *Myristica*, Swains. and *Volema*, Bolt., (or *Pugilina*, Shum.) as sub-genera of *Melongena*: I believe they are not even that, as they seem to refer chiefly to young shells of *Melongena* and *Fulgur*. The similarity is in fact very remarkable, which young specimens of *Melongena* exhibit as compared with *Fulgur* and *Hemifusus*, and the question as to the limit of these latter appears to be far from settled. The species are chiefly known from single shells, and although the animals of several of them have been observed, only few of the shells have been noticed in different stages of growth, which seems to be very important, for they show remarkable alterations in the form in different stages of age.

Adams and Chenu distribute the forms into the *FUSINÆ* and *FASCIOLARIDÆ* and it is due to Dr. Gray to state, that he drew attention to some peculiarities as to the shell and the animals of those species, which ought to form this separate group.

The head is much elongated and the tentacles very short with much thickened basis, and the eyes on bulgings on the upper external sides.

The operculum is ovate with apical nucleus, but it is not yet known in *Hemifusus*.

The shell is remarkable for the great size of the last volution, which is ventricose, enveloping the greater part of the previous whorls, and when produced into a longer canal, as in *Fulgur* and *Hemifusus*, it is slightly notched at the end; when less produced, as in *Melongena*, it is deeply notched. The spire is comparatively short,

the whorls angulate below the suture and usually ornamented with spines, or tubercles corresponding with a notch on the posterior margin of the outer lip, which is sharp, and occasionally internally striated, when the shell is thinner; the inner lip is always quite smooth, in younger specimens often angulated along the canal, but not furnished with a separate plait.

There are numerous fossil tertiary and cretaceous species, which belong to this sub-family, although most of them are usually referred to that universal denomination of *Pyrula*. The imperfectness of the specimens does not permit us to make alterations in those which have been described and figured; several of them will probably be found to belong to *Rapana* or *Tudicla* and allied genera of the *Purpuridæ*, others to *Neptunea*, *Pollia* and other genera of the *Fusinæ*.

It is equally difficult to say anything about *Perissolax*, Gabb (1861, Proc. Am. Phil. Soc. VIII, p. 122, and Pal. Calif. 1864, I, p. 91), which I think embraces a characteristic group of cretaceous shells (? the neogen *Fusus Burdigalensis*, Bast. and others) and may well stand in this sub-family. It is, however, very uncertain to state anything regarding *Pyrifusus*, Conrad (Jour. Acad. Phil. 2. ser. III, p. 332, Pl. 35, Fig. 12), and still more so as to the sub-generic name *Afer* (*ibid* p. 332, Pl. 35, Fig. 17,) of the same author; the first is actually quite uncertain, because the aperture is not known and the general form is common to a large number of other *Muricidæ*; the latter species (*F. bellaliratus*) does not seem to have any claim to be separated from *Fusus*, for it must first be proved, that the margins of the aperture were of the same kind as they are in *Fusus afer*, Reeve.

XXV. HEMIFUSUS, *Swainson*, 1840.

(Cochlidium, Gray, 1847.)

This genus is separated from *Melongena* and *Fulgur* chiefly on account of the absence of the operculum; the species attributed to it have all a long thin canal, the posterior portion of the last whorl being ventricose, inflated and the spire very short. The whorls are deeply canaliculated below the suture, the keel being sharp and the transverse ribbing terminating on the same in points, bent upwards. There are several cretaceous species, described under *Fusus*, which exhibit the characters of this genus perfectly; others which agree in the general form of the shell only. Gabb noticed the first North-American forms under the sub-generic name of *Hemifusus*, and added lately several *characteristic* species in the Palæont. of California, Vol. I, p. 86. The *Strepsidula Ripleyana*, Conr. (Jour. Acad. Phil. 2nd.ser. IV, p. 286, Pl. 46, Fig. 42) belongs evidently to this genus.

I refer here two species to *Hemifusus*, both of which bear in general the characters of the living species, usually attributed to the same.

1. Hemifusus cinctus, *Stoliczka*. Pl. X, Figs. 17 and 18.

Hemif. testa spira brevi, late conica; ultimo anfractu ad medium inflato, antice canali longo atque recto extenso; anfractibus senis, ad marginem suturalem tumescentibus, crenulatis, infra suturam excavatis atque infra excavationem angulatis, postea convexiusculis, transversim costatis; costis acutiusculis, antice in ultimo anfractu partim obsoletis; superficie spiraliter striata, striis crassioribus atque tenuioribus alternantibus, antice aliquantisper sub-granulatis; apertura perlonga, postice latiori, antice versus sensim angustiore; labro acuto, intus sulcato; labio lævigato, tenui.

Spiral angle 80°; sutural angle 6°.
Height of last whorl : total of shell (considered as 1·00) ... 0·73.

The principal characteristics of this species are the numerous transverse ribs, of which there are about twenty-two on the last whorl (their number being higher up nearly the same or somewhat less), the thick and obsoletely crenulated posterior margin of the whorls and the numerous spiral striæ, which cover the entire surface. These striæ usually alternate in strength on the last whorl and are on the excavated, posterior, portion generally somewhat thinner. The striæ of growth are very distinct on the well preserved surface of the shell, and form fine granulations on the spiral striæ. According to the elevation of the sutural margin and the posterior angle of the whorls the respective excavation between them is more or less deep, but it is always distinctly marked. The outer lip is sharpened and grooved internally, the inner lip near the posterior termination a little thickened, and the anterior canal long and straight.

When the surface of the shell is somewhat worn off the finer ornamentation disappears and the coarser spiral striæ appear more distant and sometimes granulated, as seen in Fig. 18, Pl. X; the posterior excavation becomes at the same time more obliterate.

This species so very much resembles in every way the *Voluta cincta*, Forbes, (Trans. Geol. Soc. Lond. VII, p. 132, Pl. 12, Fig. 6), that I am at a loss to give any strict distinctions between them. 'The number of longitudinal (here transverse) ribs and the strength of the spiral ones varying in almost every specimen,' says Prof. Forbes, and this is exactly what may be seen in our specimens. The spiral striæ, even when less numerous, are always stronger than in the following species, and the same is the case with the transverse ribs. The 'thickened crenulated rim' bordering the suture is equally well marked in both these similar species. Prof. Forbes states, however, distinctly, that the aperture is '4—5-plicata' and certainly he must have observed the plaits or something like them, and until this statement is disproved, or otherwise confirmed, the identification cannot be established. It is to be regretted that Prof. Forbes has not given a second view of the specimen, which he examined. He further states, that the species occurs also at Trichinopoly, which increases the difficulty, as I am unable to assign from our tolerably fair Trichinopoly collections any fossil really identical with that of Prof. Forbes. Certain it is, that in

any of our five specimens under examination, obtained from three different localities, there is not a trace of any plaits or folds on the columella, except a slight tooth-like thickening on the posterior termination of the inner lip.

Localities.—Kolakonuttom, Alundanapooram, between Andoor and Veraghoor.

Formation.—Trichinopoly group.

2. Hemifusus acuticostatus, *Stoliczka.* Pl. X, Fig. 19.

Hemif. testa spira brevi, anfractibus gradatis composita, suturis impressis junctis, infra suturam subcanaliculatis, angulatis, transversim acute costatis, spiraliter minutissime striatis; costis in ultimo anfractu duodenis, in anfractibus superioribus plus numerosis, omninis ad angulum subspinosis.

Spiral angle 66°; sutural angle 8°.

This species has the general characteristic form of others of the same genus, the whorls being contracted along the suture and the last much inflated, and—to all appearance—produced anteriorly into a straight canal, which unfortunately is not preserved in our single specimen. From the previous species, the *Hemifusus cinctus*, the present form differs remarkably by having the posterior portion of the whorl not so deeply excavated, the sutural margin being less thickened, the transverse ribs much smaller in number and thinner, and the spiral striæ only minutely marked. The spire appears to be also somewhat higher in proportion. The outer lip is quite sharp, sinuose, but not distinctly notched posteriorly; the inner lip is evidently very thin, without any posterior thickening.

Locality.—Near Comarapolliam in the Trichinopoly district.

Formation.—Arrialoor group.

b. *Sub-family—FUSINÆ.*

The animals of the *fusinæ* have the head and tentacles moderately prolonged, the eyepeduncles thickened and usually for a short distance united with the former; they are mostly of a uniform red or olive colour; the operculum is ovate with an apical nucleus; the shell has the varices all of equal strength or they are obsolete; the canal is more or less prolonged, straight or slightly recurved.

Although numerous alterations have been made, since Lamarck first introduced stricter arrangements in the genus *Fusus*, the variety of shells at present admitted in this sub-family by the greater number of conchologists is still very great and can be classed only very gradually. There would probably not be any great difficulty in making at least two farther divisions, namely, shells with strong equal transverse varices and smooth or only striated shells; but such distinction could evidently be only of very limited value. The number and characteristics of the genera are far

from being settled; the following, of several of which representatives are to be found in the South Indian cretaceous rocks, are generally distinguished.

1. *Neptunea*, Bolten, 1798. (*Chrysodomus*, Swainson, Gray's Guide, 1857, p. 13. *Volutopsis*, Mörch or *Strombella* Gray, *ibid*, *vide* H. and A. Adams' Gen. II, p. 614.) Ventricose shells with short canal, often bent to the left and somewhat upwards; whorls convex, covered with a horny, rough epidermis, usually spirally striated, transverse varices obsolete, occasionally replaced by transverse ribbings, which are of about equal strength with the spiral ones.

The living species of *Neptunea* are coated with a thick epidermis and have a comparatively thin shell with obsolete transverse varices and a spiral striation only. The name ought to be retained for these forms only, and such species, quoted by H. and A. Adams under this genus, as *N. anomala*, *funiculata*, *fusoides* and others, have to be excluded and partially placed under *Tritonidea* and others.

Tertiary species, as *Fusus glomus* and *glomoides*, Gené, and several other forms have to be transferred to this genus, thus forming a very characteristic group of shells. Numerous cretaceous species belong also to it; (*vide* Proc. Am. Phil. Soc. 1861, VIII, p. 118; Pal. Calif. 1864, I, p. 88; Sitz. Akad. Wien. 1865, LII, Rev. etc. p. 77.)

We notice two species from South India, *Nept. rhomboidalis*, Zek. sp. formerly described as *Voluta id.* by Zekeli from the Alpine Gosau-deposits, and *N. excavata*, Blanf. sp., a remarkable form of the type of *Fusus corrugatus*, Reeve, and *F. glomus*, Gené, with a coarsely reticulated shell-surface.

2. *Euthria*, Gray—Adams' Gen. I, p. 86 — Spire about as high as the last whorl, conical; whorls smooth or spirally grooved, canal short, bent to the left (in front view) and somewhat recurved, aperture ovate, posteriorly subcanaliculated, inner lip smooth, outer lip sulcated internally. The shells are more consistent and thicker than in any *Fusus*. Gray (Guide, 1857, p. 43) calls *Euthria* a *Triton* with 'abortive or rudimentary varices'. The animal in form and colour resembles no doubt more the TRITONIDÆ, than the FUSINÆ, and if three lateral teeth can be proved to exist, the genus may perhaps be better transferred to the last family. I do not know whether all the ten living species attributed by Adams to this genus belong to it, some of them resemble (at least exteriorly) *Bullia* more. There are several tertiary species, which exhibit the characters of the genus very well, and of which *Nept. cornea*, Linn. is to be considered the type; but I am not acquainted with any cretaceous form exactly like; unless species such as *Neptunea curvirostris*, Gabb (Pal. Calif. I, p. 88, Pl. 18, Fig. 37), belong to it, which certainly does not appear very improbable.

3. *Clavella*, Swainson, 1835 (*Cyrtulus*, Hinds), buccinoid or fusiform shells, with accumulated spire and sub-cylindrical graduated whorls; surface smooth, spirally sulcated and occasionally with transverse varices, last whorl much thickened along the suture and somewhat contracted below it, forming an indistinct posterior canal on the aperture, anterior canal very short or prolonged in a straight line; on the termination only occasionally bent.

This type, which is well characterised by the cylindrical shape of the whorls, and the usual irregularity in the last of them, has not been as yet met with in the cretaceous strata, but it abounds in great variety in the eocene beds, decreases very considerably in the neogene, and only four species are quoted by Adams as living: All the fossil species have tolerably prolonged anterior canals, and it is not certain whether it would not be better to reserve the name *Clavellithes* of Swainson for the species with a very short canal and an excavated columella, as *Cl. avellana* and *distorta*. (*vide Pollia.*) Species like *Cl. (Fusus) tuberculosa*, Desh. and *Cl. (Fusus) rugosa*, Lamck. form transitions to the next generic group, as restricted under the name. I do not think that there is any real necessity to separate *Thersitea*, Coquand, (Géol. and Pal. de Const, 1862, p. 267, Pl. XXIX, Figs. 30—33) from other *Clavellæ*, especially if the distinction between *Clavella* and *Clavellithes* be accepted.

4—*Fusus*, Klein, 1753.* Shell fusiform, elongated, last whorl—including the canal—shorter than the turreted spire; canal more or less produced, at least equal to the height of the last whorl, straight, inner lip smooth, outer lip grooved internally, whorls spirally striated and ornamented with rudimentary uniform varices.

The greatest number of species of *Fusus*, as restricted, are living; they are pretty numerous still in the neogene but much less so in the eocene strata, and of all the endless number of cretaceous *Fusus*, as known, only very few will be found to exhibit the characters of this genus sufficiently.

We have to notice only one species of *Fusus*, *F. verticillatus*, n. sp.

5—*Tritonidea*, Swainson, 1840. Shell ovate, buccinoid, last whorl sub-ventricose, canal short, or moderately prolonged, bent to the left, and on its termination recurved; rudimentary varices numerous, all of equal strength, crossed by elevated thick spiral lines; inner lip anteriorly thickened, smooth, posteriorly thin or cross-grooved, often toothed at the end; outer lip thin, internally sulcated. H. and A. Adams consider this group only as a sub-genus of the next, but I think it ought to be kept distinct, if once a division of the old genus *Fusus* be acknowledged.

6—*Pollia*, Gray, 1839. (*Cantharus*, Bolten, apud Adams.) Shell buccinoid, whorls convex with rudimentary and equally formed varices, and spiral elevated lines, last whorl ventricose, siphon *very* short and barely recurved; mouth ovate, inner lip thin, cross-grooved in the entire extent, and posteriorly toothed; outer lip thickened internally and denticulated.

Gray established this genus in the Zoology of Beechy's Voyage, p. 111, for a number of named and unnamed species, among the determinations of which he himself proposed afterwards great alterations; but he does not seem to notice it at all in his Catalogue of 1857. Adams quotes only five species under *Pollia* and 32 under *Tritonidea*, there cannot be however any doubt, that considerable changes must be

* The author's name designates (as in *Aporrhais*) only the first proposition of the name *Fusus*, although its characters were afterwards fixed by Bruguiére, Lamarck, a. o. and are still changing. It seems rather a mistake to substitute for such a universally acknowledged name as *Fusus* that of *Colus*, Humph., which, if it be correct, cannot have priority to that of Klein; but it is still more inconsequent in Dr. Gray to use the name *Fusus*, Humph. in another place, designating by it *Rostellaria* of Lamarck.

made in these species. Several of them, as, for instance, *Neptunea anomala, funiculata, fusoides* and others (Adams. I, p. 80) must be referred to *Tritonidea*, and again species as *Cantharus (Tritonidea) biliratus, nigricostatus, pastinaca* and others (*ibid*, p. 85,) must be transferred to *Hindsia* of the TRITONIIDÆ.

Gray (Beechy's Voy., p. 112) quotes *Buccinum (Clavella) distortum* as a *Pollia*, and it is indeed remarkable the similarity which young specimens of this species have with *Pollia*, so that it may be after all proved, that the *Clavellæ* without a longer canal are only abnormally grown specimens of *Pollia*. If this could be proved the name *Clavellithes* must necessarily be avoided.

As indicated, there must certainly be great alterations introduced, if the two genera *Pollia* and *Tritonidea* are to stand, but the numerous fossil species seem fully to indicate and to justify such a separation. Several species of both genera are described by Deshayes, Hörnes and others under *Fusus* and *Murex* (*vide* Foss. de Paris, Pl. 76 and Wiener Moll. Pl. 25, respectively).

The cretaceous species belong chiefly to *Tritonidea*, and are more numerous than in any other genus of the FUSINÆ; they are in fact the predecessors of the TRITONIDÆ or rather perhaps of the MURICINÆ, and it is only questionable whether it would not be better to place them in the next sub-family. The form of the shell agrees better with the MURICINÆ, while the form of the aperture excludes them. Most of the *Fusus* described by D'Orbigny belong to *Tritonidea*, thus forming a transitional group between *Fusus* (as restricted) on the one, and *Murex* and *Hindsia* on the other side. Several other European cretaceous FUSINÆ have to be transferred to *Pollia* and *Tritonidea*, but scarcely any representatives of them are known from North America, at least none of the *Neptunea* or *Fusus*, lately described by Gabb, are so well marked as to be reasonably transferred to any of those genera. We shall describe from the South Indian cretaceous deposits four species under *Tritonidea*, namely, *T. gibbosa*, Stol., *T. Requieniana*, D'Orb., *T. granulata*, Stol., *T. Trichinopolitensis*, Forbes, sp. and one *Pollia*, *P. Pondicherriensis*, Forbes, sp.

Pisania (Pusio) and *Metula* appear to be better classed with the COLUMBELLIDÆ according to Gray.

I have thus given a review of the genera of the FUSINÆ, merely to shew what forms seem to be represented in the cretaceous formations, and how they may be traced. Were our fossil, mesozoic, materials usually better preserved, I have no doubt that several typical forms could be distinguished with generic names; and that in this way only can the daily doubts and objections as to species, which all are termed *Fusus*, be cleared up.

Pictet (Mat. Pal. Suisse, 3me. Ser. pt. II, pp. 642—650) enumerates 106 species of *Fusus* (= FUSINÆ and FULGURINÆ) from the cretaceous deposits of Europe only. There is not the slightest question, that not much more than half of these are true species properly belonging to this (and the former) sub-family, but it is difficult to say, when, or whether we shall ever come to such a knowledge of them as is desirable. It cannot be wondered at, that nearly every one, having procured a good

specimen, prefers giving it a new name, rather than identifying it with some uncertain cast, even when compared in original. A revision of the present species of cretaceous *Fusus* would be a tremendous work, although undoubtedly most important for the development and early study of the SIPHONOSTOMATA, but it could not be carried out without access to the original materials.

I have lately examined the Gosau species (Sitz. Akad. Wien, 1865, LII, Revis. etc. p. 81) and found, that of sixteen species described by Zekeli, only two could be retained, of which the *Fusus cingulatus*, Sow., is most probably not a *Fusus*, but a *Terebra* or *Bullia* or an allied genus; and the *Fusus Reussi*, Zek. may be proved to be a *Latirus*, as may also be expected with the *Fusus torosus*, which I added (l. c. p. 83) to the genus. (*Voluta torosa*, Zek.) We may have then out of sixteen cretaceous *Fusus* not one even of the sub-family *FUSINÆ!* certainly not one true *Fusus;* but this is surely not the case with other described species, at least not to that extent, and there are numerous *FUSINÆ* well known, as stated previously. The American species of *FUSINÆ* are between forty and fifty.

Forbes did not describe a single *Fusus* from South India, but numerous mistaken species have been attributed to him by subsequent correctors. I shall notice them briefly and append some remarks with regard to the alterations, which have been thought necessary.

1. *Voluta purpuriformis*, Forbes—*Fusus* id. D'Orb.—is *Athleta* id. (see *VOLUTINÆ* p. 91).

2. *Rostellaria cancellata*, Forbes, loc. cit. p. 128 } = *Fusus subcancellatus*,
„ *cancellifera*, *ibid*, Pl. 13, Fig. 18 }

D'Orb. could not be traced, but the fragment certainly belongs to an *Apporrhais* or *Alaria*, never to a *Fusus*, nor to any species of the *FUSINÆ*. It may be a fragmentary specimen of the upper whorls of *Ap. securifera*, Forbes (*vide* p. 28, Pl. II, Figs. 2—3).

3. *Phasianella inverta*, Forb. = *Fusus subincertus*, D'Orb. must provisionally remain as a *Phasianella*, as it is certainly not a *Fusus*, nor does it appear to belong even to that sub-family.

4. *Pyrula cancellata*, Sow. (apud Forbes) = *Fusus Forbesianus*, D'Orb. is a *Rapa*.

5. *Triton atavus*, Forb. = *Fusus id.*, D'Orb., must remain as *Tritonium*.

6. *Murex fluctuosus*, Forbes = *Fusus* id. D'Orb., must remain as *Murex* provisionally (*vide* p. 129), until the species can be identified from better preserved specimens.

7. *Murex Pondicherriensis*, Forb. = *Fusus* id. D'Orb. is *Pollia* id. *vide* p. 127.

8. *Voluta breviplicata*, Forb. = *Fusus* id. D'Orb. is *Cancellaria (Euclia)* id. of *CANCELLARIIDÆ*.

9. The *Pyrula Pondicherriensis*, Forb., is identical with *Pyrula Carolina*, D'Orb., and has been described as *Ficulopsis Pondicherriensis* in the sub-family *VOLUTINÆ*: *vide* p. 85.

10. *Fusus ponderosus*, D'Orb. is *Athleta purpuriformis*, Forb. sp. (*vide* sub-fam. *VOLUTINÆ* p. 91).

11. *Fusus Fontanieri*, D'Orb., is *Rostellaria* (?) *palliata*, Forbes.

12. *Fusus buccinoides*, D'Orb. (Astrolabe, Pl. 7, Figs. 41 and 42) = *F. subbuccinoides*, D'Orb. (Prod. II, p. 229) I am unable to trace; it is possible that it belongs to *Neptunea excavata*, Blanf. sp. (*vide* p. 121), but as the sutural furrow is wanting in D'Orbigny's figure, the species must remain doubtful; it would, however, in all probability be classed under *Neptunea*.

After the exclusion of the doubtful forms we have then from the South Indian cretaceous rocks eight species of *FUSINÆ* described on the following pages under the generic names of *Neptunea*, *Fusus*, *Tritonidea* and *Pollia*. I have already stated in my previous remarks the limits within which I believe these generic groups ought to be taken.

XXVI. NEPTUNEA, *Bolten*, 1798.

1. NEPTUNEA RHOMBOIDALIS, *Zekeli*, *sp.* Pl. X, Fig. 21.

1852. *Voluta rhomboidalis*, Zekeli, Abhandlungen d. Geol. Reichs-Anst. Wien, Vol. I. Pt. II. p. 80, Pl. 14, Fig. 9.
1865. *Neptunea id.* Zek. sp., Stoliczka in Sitzungsb. Akad. Wien. LII, Revis. etc. p. 78.

Nept. testa ovate-rhomboidali, anfractibus quinis, suturis impressis sejunctis, subplanis; ultimo maximo, spira longiore, subinflato; superficie in junioribus spiraliter numerosissime striata atque transversim costulata, in ætate provectiore striis costulisque plus minusve obsoletis; apertura elongata, utrinque acute terminante; marginibus arcuatis; labro acuto; canali producto, lateraliter curvo.

Spiral angle 66°; sutural angle 8°.
Height of last whorl : total of shell (considered as 1·00) ,,. 0·65

There has been only a single specimen of this species found in South India, and in comparing it with specimens from the Gosau-deposits, the differences are so slight that I cannot hesitate to identify it with the European fossil.

In my revision of the Gastropoda of the Gosau-formation (loc. cit.) I had already remarked, that the volutions ought to be a little narrower along the suture, than Zekeli's figure gives them, and that the canal is bent laterally. It may farther be noticed that Zekeli's enlarged figure 9′ represents the species somewhat broader, the last whorl being more angulated about the middle, while it is more uniformly rounded in our figure. The reason for this is, that Zekeli's figure refers to a younger specimen, while ours is one of more advanced age, although it is, excepting the anterior termination of the canal, quite perfect as regards form. The ornamentation is not so distinct in our specimen, but this is more due to a deficient state of preservation of the surface, than perhaps to the larger size, although the transverse striæ become decidedly less strongly marked in advanced age, as I had occasion to observe

repeatedly on the Alpine specimens. The posterior margin of the whorls along the suture is generally somewhat more strongly marked, the last spiral furrow being usually deeper than the preceding.

Locality.—N. of Karapaudy in the Trichinopoly district; besides the Alpine Gosau-deposits, in the valley of the Gosau, I am not aware, that the species has been noticed from any other locality.

Formation.—Arrialoor group.

2. Neptunea excavata, *Blanford, sp.* Pl. XI, Figs. 1—3.

1862. *Fusus excavatus*, Blanford, Mem. Geo. Surv. India, IV, p. 118—name only.

Nept. testa ovata; anfractibus quinis seu senis, convexis, suturis profundis sejunctis, transversim atque spiraliter crassatim costulatis, in superficie cancellatis, atque subtuberculatis, prope suturam unisulcatis; ultimo anfractu spira longiore; apertura elongata, postice acute-angulata, subcanaliculata, antice effusa; labro margine undulato, intus sulcoso; labio moderato, postice paulum expanso, intus lævi, valde arcuato; canali lateraliter curvo.

Spiral angle 70°—80°; sutural angle 4°—5°.
Height of last whorl : total of shell (consd. as 1·00) ... 0·65—0·70

The peculiar mode of ornamentation recalls very much the similarity of shells, which have folds on the inner lip and are consequently placed in the family *Volutidæ*, but there is not a trace of folds perceptible in the present species, and as the general form agrees with others of the same genus, we think it best to describe it under *Neptunea*. The form of the shell varies a good deal, some specimens being more inflated, short, and others having a more elongated spire, which however is always shorter than the last whorl. The ornamentation is equally very much subjected to variation; the normal state seems to be, when the transverse and spiral ribbings are about equal in strength, forming small nodules where they meet, and giving the surface a coarsely reticulated or cancellated appearance. The square fields between each four nodules are respectively deeply excavated, from which fact Mr. Blanford's name was derived. This regular mode of ornamentation, as seen partially in Fig. 1, is however not very often met with, chiefly from the commonly imperfect preservation of the shell-surface. Either the transverse, or more frequently the spiral ribs appear stronger, forming more or less isolated rows of tubercles, and in this way alter the appearance, as will be better seen by a comparison of our figures. The broad furrow along the suture is characteristic and is never wanting.

The margins of the aperture are somewhat dilated and thickened, being on the outer lip slightly undulated and interiorly grooved, while the inner lip is perfectly smooth. The canal is produced and bent laterally.

This species has, as regards the form of shell, the most striking resemblance to *Volutilithes limopsis*, Conrad (Journ. Am. Acad. Phil. IV, p. 292, Pl. 47, Fig. 24)

from the eocene rocks of Alabama, in which species Conrad records three plaits on the inner lip. There is no difficulty as to confounding specimens of this *Neptunea* with *Volut. radula*, Forbes, even when the plaits in the latter are not visible, as the spiral and transversal ribbings in this last named species are much more closely placed to each other and the square interspaces consequently much smaller.

Localities.—N. of Kunnanore and E. of Anapaudy, Serdamungalum, Kolakonuttom, Shutanure, Andoor, E. of Veraghoor. The species is very common at the locality between the first two named places and not rare at the others.

Formations.—Trichinopoly and (?) Arrialoor groups. To the last group only the Veraghoor locality refers, according to Mr. Blanford's map.

XXIV. FUSUS, *Klein*, 1753.

1. Fusus verticillatus, *Stoliczka*. Pl. X, Fig. 20.

Fus. testa elongata; anfractibus angulate-convexis, supra valde constrictis, transversim minutissime-, spiraliter crasse-striatis; striis spiralibus alternatim fortioribus, una ad medium anfractuum carinata, maxime elevata, obsolete tuberculata, secunda infrá crassiore, atque ceteris in basi ultimi anfractus sensim tenuioribus, supra carinam striis senis, alternatim fortioribus, ornatis; labro ad marginem tenui, sulcato; labio tenuissimo; canali recto.

Spiral angle 46°; sutural angle 11°.

This species is well characterized by its ornamentation, the transverse striæ of growth being only minute, although very distinct, while the spiral striation is much stronger. Each of the whorls is angulated in the middle by a sharp, obsoletely tuberculated carina, and above this there are, with the exception of the sutural margin, six striæ, alternately stronger and thinner; the second of the striæ below the carina is strongly marked on the last whorl and the following three become gradually thinner towards the anterior extremity, alternating regularly with others in strength. The striæ of growth are only very slightly elevated in crossing the spiral striæ and produce occasionally slight undulations of the latter. The inner lip is thin, the spiral striation being consequently partially apparent on the interior margin of the aperture; the canal quite straight; the outer lip sharp with an undulated margin, being slightly grooved internally.

Locality.—N. of Odium, in a brownish calcareous sandstone, very rare.

Formation.—Ootatoor group.

XXV. TRITONIDEA, *Swainson*, 1840.

1. Tritonidea gibbosa, *Stoliczka*. Pl. XI, Fig. 5.

Trit. testa elongata, ad medium gibbosa, utrinque aculiuscula; anfractibus octonis, primis duobus minutis, lævigatis atque politis; (in specimine cyaneo-coloratis), sequentibus convexis, prope suturam multo angustioribus, spiraliter dense striatis, infra transversaliter tuberculato-costatis; spira brevi, acuta; ultimo anfractu latissimo, gibboso, costis ad medium convexitatis crassis, tuberculosis, striis suprâ et prope suturam tenuioribus; canali spiræ sub-æquali, paulum lateraliter atque supra recurvo; labio antice calloso, postice tenui; labro acuto, margine undulato, intus sulcoso.

Angle of the spire (excepting the last whorl) 35°; sutural angle 6°.
Height of last whorl : total of shell (consd. as 1·00) ... 0·63.

The great number of whorls, being strongly contracted on the suture and the ast being more than twice as wide as the penultimate, but rapidly narrowing on the anterior extremity again, give this shell a very characteristic form, which, combined with the ornamentation and the shortness of the canal, recalls very much the similarity of some species of the family *Tritonidæ*.

The figured specimen is in excellent preservation, and on this the two uppermost whorls are perfectly smooth with a blueish tinge; it is probable that this colouring is original on the shell. The whorls next to the embryonal are only spirally striated, and the transverse ribs do not appear until on the third before last, being obsolete near the suture, where the spiral striæ are considerably thinner. On the last whorl they may be said to form transversally elongated tubercles, ten in number. The spiral striæ are strongest in crossing these tubercle-like ribs, and become towards the anterior extremity broader, but less elevated, and gradually obsolete. The striæ of growth are distinctly perceptible, but very fine.

The aperture is somewhat pear-shaped, broadest above and gradually narrowing and lengthened anteriorly. The outer lip is sharp, internally grooved; the inner lip quite smooth, posteriorly thin, anteriorly somewhat thickened; the canal is laterally curved with its termination somewhat turned upwards. Near this termination the inner lip is somewhat thicker, forming a very slight fissure exactly similar to the largest number of living *Tritonideæ*.

This species bears evidently considerable resemblance to *Fusus Marrotianus*, D'Orb. (Pal. Franç. terr. crét. Pl. 225, Fig. 2), as regards general form and spiral striation, but the smaller number of whorls with a somewhat more obtuse spiral angle and the few transverse ribs on each of them appear to justify fully the proposed distinction of the two species. J. Müller (Petref. d. Aachner Kreidef. 1851, p. 34) unites the *F. Marrotianus*, D'Orb. with *F. Clementinus* of the same author. The forms of both and our own species are like enough, but as D'Orbigny's figure of the last-named species represents only a very poorly preserved cast, the question cannot be settled satisfactorily without the original specimens.

Locality.—N. of Alundanapooram in the Trichinopoly district; very rare.

Formation.—Trichinopoly group.

2. Tritonidea requieniana, *D'Orbigny, sp.* Pl. XI, Figs. 8 and 9.

1842. *Fusus Requienianus*, D'Orbigny, Pal. Franç, Terr. crét. p. 342, Pl. 225, Fig. 3.
1851. „ *Buchi*, Müller, Petrefacten der Aachner Kreideform. p. 35, Pl. V, Fig. 15.

Trit. testa elongata, spira acuta; anfractibus circiter septenis, convexis, superioribus cancellatis, ceteris crasse spiraliter striatis transversimque costatis; costis 10—12 *in uno circuitu, ad medium maxime elevatis, antice in ultimo anfractu obsoletis, postice tenuioribus, usque ad suturam prolongatis; striis crassis minutissimis alternantibus; ultimo anfractu maximo, gibboso; canali lateraliter atque suprá recurvo; labio tenuissimo.*

Spiral angle 55°—65°; sutural angle 8°.

The shell consists of four—seven convex volutions, the spire, when well preserved, being of about the same length as the last of them. Each of the whorls of the spire is ornamented by ten—twelve transverse ribs and about five spiral striæ. The two uppermost (posterior) of these striæ are placed somewhat closer to each other and are thinner than the following. When the shell-surface is well preserved a very fine spiral striation is perceptible between each of the stronger striæ. The anterior portion of the last volution is striated similarly to the rest of the shell, but the transverse ribs disappear perfectly on it. All the whorls are posteriorly somewhat more contracted than anteriorly; the ribs are slightly curved, reaching from one suture to the other, being, however, posteriorly considerably thinner, while the spiral striæ increase a little in thickness, where they cross the transverse ribs.

There exists scarcely any difference, that we could record between our specimen, represented in figure 9*a* and D'Orbigny's figure. The uppermost whorls are in our specimen corroded, and on that account only the spire appears to be somewhat shorter. There are ten transverse ribs on each volution in D'Orbigny's specimen, while there are twelve in ours; this number appears to change, however, often in one and the same specimen.

It seems very desirable to compare specimens of *Fusus Itierianus*, D'Orb. (loc. cit. Pl. 223, Fig. 2) with those of the present species, for both the figures of D'Orbigny are remarkably alike. The only perceptible distinction is, that the whorls are posteriorly somewhat less contracted in the former, but the difference does not seem to exceed the limits observed in our materials. The fine striation between the coarser in *F. Itierianus* cannot be looked upon as a character of specific difference, for it depends merely upon the state of preservation. I have placed the *Fusus Buchi*, Müller, as a synonym of *F. Requienianus*, although Dr. Müller says that it differs in every way from it. Comparing however the description and figure of the former the only difference which can be noted is a somewhat larger number of whorls and of transverse ribs; in both these points the identity is perfect with our smaller specimen represented in Fig. 8, Pl. XI. The real fact appears to be, that the uppermost whorls are gradually worn off with the advanced age of the specimen. The variation in the number of transverse ribs has already been noted, and that they appear a little sharper, is a matter which may reasonably be expected in younger specimens.

D'Orbigny described his *Fusus Requienianus* first from the chloritic beds of Uchaux and transferred it in his Prodrome to the 'Turonien.' The *Fusus Buchi* of Müller occurs in the 'Grünsand' (about equivalent to the upper Greensand of English geologists) of Aachen (Aix-la-Chapelle). In general the species may be regarded as a middle cretaceous fossil.

Localities.—East of Anapaudy in a soft chloritic rock and near Veraghoor in a whitish sandstone, in Trichinopoly district; rare.

Formation.—Trichinopoly group.

3. TRITONIDEA GRANULATA, *Stoliczka.* Pl. XI, Figs. 6 and 7.

Trit. testa ovato-conica; anfractibus subconvexis, posterius ad suturam margine tumescente atque una serie granorum ornatis, infra marginem profunde canaliculatis, infra canalem costis crassis transversalibus atque striis spiralibus ornatis; costis circiter denis in uno circuitu, rectis, tuberculate-elongatis, antice evanescentibus; striis plus minusve granulosis, in anfractibus spiræ ternis seu quaternis, in ultimo numerosis; canali anteriori elongato, prope recto.

Spiral angle 55°; sutural angle 10°.

This species is referred to *Tritonidea,* chiefly on account of its general resemblance to other species; no specimen has been observed with the anterior portion of the canal perfectly preserved. In general form and partly in the ornamentation, the present species resembles much the *Trit. Requieniana.* The specific distinctions are, however, pretty clearly marked, for not only the single whorls are less convex, but the entire ornamentation differs in its greater details. The posterior margin along the suture is much thickened, ornamented with a row of numerous spinose tubercles; below it there is a strong constriction like a canal, on which the transverse ribs terminate. The number of the granules on the sutural margin is much larger than the number of transverse ribs, so that the former cannot be regarded as the upper terminations of the latter. All the stronger spiral striæ are more or less granulated and form pretty sharp tubercles in crossing the transverse ribs. There are, at least in young specimens, very fine intermediate striæ to be observed between the stronger ones, of which three or four are present on the upper whorl. The uppermost of these latter is somewhat thinner than the lower three.

The inner lip is distinctly striated, but on the anterior portion apparently thicker, than in *Pollia Pondicherriensis*; the outer lip is internally grooved. The last whorl is somewhat higher than the spire, and the anterior canal is for the greater portion of its length almost straight.

Locality.—S. E. of Parchairy in the Trichinopoly district, apparently very rare.

Formation.—Trichinopoly group.

4. Tritonidea Trichinopolitensis, *Forbes, sp.* Pl. XI, Fig. 4.

1846. *Murex Trichinopolitensis*, Forbes, Trans. Geol. Soc. Lond. VII, p. 127, pl. 15, fig. 7.
„ *idem* D'Orbigny; Gabb; Pictet; &c.

Trit. testa elongata, ad medium inflata, utrinque attenuata; anfractibus senis primis lævigatis, ceteris costate-cingulatis, transversim costatis, ad medium angulatis; supra angulum duobus striis fortioribus atque multis minoribus ornatis, costis subobsoletis; apud et infra angulum crasse tri-cingulatis, in interstitiis etiam multistriatis; costis transversis rectis, ad angulum nonnunqnam tuberculosis seu spinulosis; ultimo anfractu antice canali moderato protracto, valde constricto; labio intus lævigato, postice tenui, antice incrassato; labro ad marginem intus sulcoso; canali ad terminationem lateraliter atque supra recurvo.

Spiral angle 65°; sutural angle 8°—9°.
Height of last whorl : total of shell (considered as 1·00) ... 0·60—0·65.

Between the principal spiral striæ there is always a dense and fine striation perceptible, and some of these secondary striæ vary again in strength. On the upper flat portion of each whorl there are only two stronger striæ and on the lower (on the last whorl the middle) straight portion three, respectively much thicker, and the uppermost occasionally forming rounded tubercles on the edges of the transverse ribs. These latter become obsolete on the posterior portion of each whorl as well as on the anterior portion of the last. The striæ of growth are very distinct and produce occasionally with the finer striation a kind of minute granulation. The canal is only slightly bent laterally, but it is more strongly bent upwards than in any of the other species, and on its termination it appears to be also somewhat widened. The inner lip thickens somewhat towards the anterior extremity. The only known species which it would seem very desirable to compare with the Indian fossil, is *Fusus Nereidis*, Münst. (in Goldf. Petref. Germ. III, 1841-1844, p. 24, Pl. 171, Fig. 20). A perceptible difference, judging from Goldfuss' figure only, lies in the spiral striation, although this could be easily explained from the state of preservation. Münster's species appears to be pretty common in the middle cretaceous deposits of Germany; (*vide* Zeitsch. Deutsch. Geol. Gesell. XV, p. 340).

Localities.—N. of Alundanapooram and S. of Olapaudy; appears to be a rare shell.

Formation.—Trichinopoly group.

XXVI. POLLIA, *Gray*, 1839.

1. Pollia Pondicherriensis, *Forbes, sp.* Pl. XI, Figs. 10—12.

1846. *Murex Pondicherriensis* Forbes, Trans. Geol. Soc. Lond. VII, p. 127, Pl. 13, Fig. 20.
1850. *Fusus* „ D'Orbigny, Prod. II; *idem*, Gabb; Pictet; and others.

Pol. testa ovata, apice acuta; ultimo anfractu maxime inflato; anfractibus circiter septenis, convexis, supra angustioribus, planiusculis, transversim 12—16-*costatis, spiraliter costato-striatis; striis crassis in costis transversalibus fortioribus, nonnunqum subtuberculosis, una seu duabus minoribus, filiformibus, alternantibus; apertura ovali; labro ad marginem intus sulcoso; labio tenui; canali brevissimo (?).*

Spiral angle 60°—68°; sutural angle 6°.			
Height of last whorl	: total of shell (considered as 1·00) ...	...	0·61—0·62.
Width of „ „	: its height („) ...	..	0·92.

All the whorls are much more strongly contracted above than below and somewhat flattened, while the lower portion is strongly convex. The transverse ribs, which vary between 12 and 16 in number, are posteriorly thinner, but can be generally traced up to the suture. Besides the sutural line there are usually on the flattened portion of the whorl three striæ, the middle one being the strongest, and three others, respectively much stronger than the previous, are placed on the lower portion. As the size of the shell increases, thinner striæ appear gradually between the principal ones, but there are very rarely more than two of them between two of the former. When the shell surface is well preserved the striæ of growth are found to produce on the spiral striation a fine granulation, otherwise they appear some what distinct only in the interstices.

The aperture is ovate; the outer lip on its margin internally sulcated; the inner lip not much thickened and partially crenulated and striated. The canal was certainly short, and although it has not been observed with its termination perfect in any of our numerous specimens, it could scarcely differ in form very much from that of living species of the same genus, as may be seen in the restored Fig. 10 or 11, Pl. XI. I may remark here, that this specimen is very nearly perfect, and that only a portion of the margin of the outer lip is broken away, the impressions of the interior sulcation being well preserved. The ornamentation not being otherwise unlike, I have long been in doubt whether it would not be more appropriate to refer this species to *Phos*, Montfort, but the want of a separate anterior fold on the inner lip and the comparatively great thickness and solidity of the shell agrees undoubtedly better with living species of *Pollia*.

Prof. Forbes described this species as *Murex*, pointing out distinctly the shortness of the anterior canal, and there does not appear much reason to support D'Orbigny's views in transferring the species to *Fusus*, from which *Pollia* as at present accepted must be kept totally distinct, intermediate between the sub-families *MURICINÆ* and *FUSINÆ*.

Localities.—Alundanapooram, neighbourhood of Anapaudy and Veraghoor, in the Trichinopoly district; a tolerably common shell.

Formation.—Trichinopoly group.

c. *Sub-family,—MURICINÆ.* (Adams, Chenu, Gray and others.)

The animals of the *MURICINÆ* are almost exactly like those of the *FUSINÆ*, at least they do not exhibit any greater variations, except that the margins of the mantle are generally more developed and form usually at an interval of one-third of each volution stronger spinose or lamellar varices in the former sub-family. The aperture of the shell is round, internally smooth and only the margin of the outer lip often undulated; in a great number of species the canal is externally, up to a narrow open line, closed; the operculum is ovate with a sub-apical nucleus.

It is certainly necessary to divide this family into at least four genera (or rather five) as proposed by Dr. Gray (Guide, 1857, p. 11) and others.

1. *Murex*, Linn. 1758, restricted to the species with a short spire, ventricose, strongly convex whorls, thick varices with or without single spines, and a long canal.

The *M. spirilla*=? *Tudicla* of Adams and Chenu excluded.

2. *Chicoreus*, Montfort, 1810, with three principal and more or less sub-equal spinose and lamellarly branching varices, last whorl usually somewhat higher than the spire, canal short with its termination bent to the right.

2a. *Pteronotus*, Swains. 1840.—Of the other sub-genera, quoted by Adams, this ought I believe to be established as a genus, comprising chiefly elongated shells with the spire about the same height as the last whorl or even somewhat higher, each whorl ornamented with three laterally much compressed, fin-shaped varices; secondary varices more or less obsolete, the interspaces being often quite smooth, the canal of moderate length, externally usually perfectly closed by the extended margins of the aperture, the termination straight or only very slightly bent. There are a considerable number of tertiary fossil species, which indicate this separation as very desirable.

3. *Typhis*, Montf. 1810, characterized *especially* by the tubular canal near the posterior edge of the mantle; includes a large number of typical shells.

4. *Trophon*, Montf. 1810.—The varices are numerous, lamellar, single and equally formed, posteriorly angulated, prolonged into short lamelliform spines, hollowed out internally; the anterior canal is open, of moderate length and usually bent to the left (in the frontal view of the shell).

The sub-family, as at present restricted, forms a very well defined, natural group of shells, and each of the genera, as here stated, have numerous representatives in neogene and eocene beds. By much less certain, however, is any knowledge of the cretaceous species, attributed to this same group of shells. The following cretaceous species have been recorded by Pictet (Pal. Suisse, 3me Ser. p. II, p. 660); *M. Prestensis*, P. et Camp; *M. Genevensis* P. et R.; *M. carinella*,

Sabaudianus et *bilineatus*, P. et Camp; *M. calcar*, Sow.; *M. pleurotomoides*, Müller. In my revision of the Gosau-Gastropoda (Sitz. Akad. Wien, 1865, LII, p. 80), I have mentioned as doubtful *M. loricatus* (*Tritonium id.* Zek.); and I actually do not know where the two last named species could be better placed, although they have no intermediate stronger but all very sharp varices, as most of the species of *Chicoreus* have, to which genus alone they can form additions. The six first named species may belong to the same group, but they are not so perfectly known as to admit of their difference from *Pollia* and *Tritonidea* of the *FUSINÆ* being positively stated. All this is to be looked for with better materials, and the generic denomination of *Murex* shows in general only, that the species most probably belong to the *MURICINÆ*. Of the three species noted by Prof. Forbes as *Murex* I have referred the *M. Pondicherriensis* to *Pollia* and *M. Trichinopolitensis* to *Tritonidea* of the *FUSINÆ*, but I am not able to trace *M. fluctuosus*, nor could I pronounce an opinion on its generic denomination. The species may prove to belong to this or to the former sub-family; it ought provisionally to stand here, as no reason can be given for its being shifted about into other groups.

Gabb lately described a very interesting species, *Typhis antiquus*, from the cretaceous rocks of California (Pal. of California, 1864, I, p. 82, Pl. 18, Fig. 31.); it is the first representant of the genus in cretaceous beds. We notice from South India another equally remarkable species belonging to the sub-family *MURICINÆ* and in all probability to the genus,

XXVII. TROPHON, *Montfort*, 1810.

1. TROPHON OLDHAMIANUM, *Stoliczka*. Pl. XI, Fig. 13.

Troph. testa elongata, fusiformi; anfractibus gradatis, supra valde-excavatis, ad marginem suturalem subinflatis, infra planiusculis, spiraliter crasse striatis, transversim lamellose costulatis; costulis supra in excavatione obliquis, ad angulum spinulosis, infra rectis, in striis spiralibus lamellose-elevatis, plus minusve muricatis; labio lævigato, tenui; apertura ?—canali ?—

Spiral angle 44°; sutural angle 9°.

This very characteristic fossil agrees in every respect so entirely with living species of the genus *Trophon*, that there can be little doubt as to its being a representative of this group in the cretaceous deposits.

All the whorls are along the suture deeply and broadly excavated, below nearly flattened ornamented with coarse spiral striæ, which are usually unequal in strength, numerous on the last whorl, while only three remain visible on the previous, and gradually disappear towards the uppermost. The margin of the suture is somewhat swollen up; on the excavated portion below no spiral striation is visible, but the oblique transverse ribs, which are nearly straight on the lower portion, are here lamellar and more or less elevated into spines on crossing the spiral striæ, especially so on the angle, which bounds the excavation below.

The specimen under description is rather imperfect, neither the apex nor the aperture is preserved, but the very characteristic ornamentation may for the present serve as a sufficient distinction. The inner lip is thin and smooth; near the suture the shell is remarkably solid.

Locality.—S. of Serdamungalum in Trichinopoly district; apparently very rare; only the figured specimen has been examined.

Formation.—Trichinopoly group.

XI. *Family.—TRITONIIDÆ.*

Animal with a thickened, truncate head; tentacles of moderate length, with the eyes on the external thickened basis, or within the first half of their length; proboscis long, retractile; lingual membrane, with teeth in seven rows, the lateral in three series each; mantle enclosed; siphon usually produced and nearly straight; foot always expanded, with thin margins, truncate anteriorly.

Operculum ovate, lamellar, of the same size as, or occasionally smaller than, the aperture, and with an apical or lateral nucleus.

The shells are more or less ovate, usually thick and consistent, covered with a rough, horny epidermis; the whorls ornamented in the course of growth with permanent apertural varices, of which at least the last one is always distinguished, even when all the previous become obsolete; the surface is usually roughly covered with spiral striæ and more or less spinose tubercles; the aperture is ovate and both lips usually denticulated or sulcated; the inner lip has often posteriorly an elongated tooth so as to narrow by it the aperture; the canal is more or less produced.

The genera usually admitted in this family are *Ranella* (*Bursa*, Adams, *Apollon*, Gray) *Persona* (*Distortio*, Adams), and *Tritonium*, of the first and last of which H. and A. Adams quote a number of sub-genera. Gray restricted the name *Ranella* for *R. crumena* (and ?), as distinguished by a semiovate operculum, with a centro-lateral nucleus, and places it in the *Cassididæ* (Guide, 1857, p. 39). If this be admitted, *Persona* in having a similar operculum and differing far more in the constitution of the shell must be separated from the *Tritoniidæ* also. There does not seem any particular necessity for either change, as otherwise nearly the entire family must be disbanded.

A generic distinction of those species, as *R. crumena*, within the family *Tritoniidæ*, appears quite sufficient. It cannot be questioned that the present distinction, as accepted between *Ranella* and *Tritonium*, based principally upon the number of varices in one whorl, is very uncertain. When Philippi searched anxiously after other distinctive characters between *Ranella* and *Tritonium*, it shows only that he had carefully observed a number of one and the same species in different stages of growth. For if any body has had the opportunity of examining a really large number of these living shells on the sea-coast, he will easily be convinced, that he could make a good number of species of *Tritonium* and *Ranella*

too out of one series of shells, of which the animals are evidently perfectly the same as regards any specific distinctions. All that appears likely is, that any classification depending upon the existence of two varices in one, or three in two whorls, must be given up as of principal importance, and that a number of genera ought then to be framed according to the general form and a summary of other distinctive marks, as has been partially proposed by H. and A. Adams. It must be granted that the varices are in many species scrupulously constant in their position, and that they will always form good marks of distinction, but certainly they are not so to the extent of forming strict generic separations. So long, however, as only specimens of 'distinguished beauty' are recorded and represented in our collections, it is indeed a difficult task to entertain hopes, that any one will succeed in a generic arrangement of the family. The following would perhaps summarise the present state of our knowledge.

1.—*Ranella;* as in Gray's Guide, 1857, p. 39; the examination of the opercula only can fix any certainty of distinction from

2.—*Lampas;* ovate shells, with distinct and open posterior canal, very short anterior canal like *Tritonium lampas*, *Ranella foliata*, and others (*Aspa*, Adams, included).

3.—*Apollon;* produced anterior canal; last whorl ventricose; outer lip much thickened on the margin; no, or at least not an open, posterior canal, with two varices on each whorl; species like *Ranella gigantea*, *gyrinus*, and others.

4.—*Eupleura;* as stated by Adams, Genera, I, p. 107.

5.—*Persona;* (*Distortio*, Adams, Gen. I, p. 104.)

6.—*Simplum;* shell ovate; whorls nodulose; last ventricose; canal distinct, more or less produced; margins of aperture strongly thickened; outer lip exteriorly bounded by a varix, internally thick, dentate; posterior canal indicated, not open. Under this name could probably be better included the species quoted by Adams in the sub-genera *Simplum*, *Cabestana*, *Lottorium*, and *Gutturnium*, *Tritonium and Clandestinum*, Chem, and others. The distinction from *Apollon* would be based simply upon the number of tubercles within restricted limits. Imperfect specimens will be difficult to separate from *Tritonium*, although from the nature of the outer lip the varices ought to be always much stronger.

7.—*Epidromus*; vide Adams' Gen. I, p. 103, probably not excluding *Ranella anceps*.

8.—*Tritonium*,* as restricted (Adams' Gen. I, p. 102), ovately elongated, canal short; outer lip thickened in front, somewhat reflected with sharpened outer edge; inner lip thin, posteriorly more or less expanded, and near the posterior angle of the aperture with a fold-like tooth;—*Ranella candisata* probably included.

9.—*Lagena;* shell thin, more like that in *Neptunea;* whorls roundish or angulated with short transverse ribs, and mostly obsolete varices; margins of the aperture continuous; inner lip with a fold-like tooth posteriorly; outer lip internally

* In a case so easily remedied as this, I do not see the advantage of supposing, that the meaning applied to a word by any one should be misunderstood as applying to a reptile, where he is only speaking of a shell.

smooth with broad sulci; externally inflated forming a varix, but not much thickened; canal usually somewhat produced; columella solid. This genus ought to be certainly distinguished from *Tritonium* and the other genera, being well characterized by the thinness of the shell as compared with other *Tritonidæ*. We noticed the same difference, accompanied with other distinctive characters (as stated), on two species from the South Indian cretaceous rocks, the description of which will be found more in detail farther on under this generic heading. Chenu entertains, as I believe justly, some doubts as to the species attributed by Adams to this genus.

If the *Trit. Tranquebaricum*, Linn., be not separated from *Simplum*, there is certainly no reason to do so with *Tr. clandestinum*, Lamk. for both have the characteristic form and thickened outer lip of *Simplum*, except that the varices become on the upper volutions more or less obsolete. There is usually only one varix on the last, and sometimes one, two, or three preceding ones well developed on the previous volutions, but I do not think that there is any great necessity for separating these forms from *Simplum*, save on account of the few differences in the structure of the shell; certainly they are not to be united with *Trit. cancellatum*, Lamk., *T. Oregonense*, Say, *T. Chemnitzii*, Gray, and others in one genus. The *Trit. (Buccinum) glaciale*, Müller, ought, I believe, to be placed here and not under *Buccinum*.

10.—*Argobuccinum* (*vide* Adams' Gen. I, p. 104). This genus would seem to differ only by the more solid structure of the shell, and by the outer lip being internally thickened and dentate, the canal short, recurved; it could be retained for *Tr. scabrum*, King, *Ranella Argus*, Lamk., *R. vexillum*, Sow., and a few tertiary fossil species. The *Trit. rude*, Brod., appears rather to be a *Pollia*.

11.—*Hindsia*,* *Adams*, 1850; (*Nassaria* in Adams' Gen. I, p. 123; *Hindsia* of Chenu). Excepting the last varix on the margin of the outer lip, there is no other one distinguished from its size, although the whorls are transversally numerously ribbed; the canal is produced and recurved; the aperture roundish; the inner lip transversally grooved, and the outer lip internally thickened and dentate. These characters distinguish the shells of this genus easily from *Lagena* and *Argobuccinum*.

Gray (Guide, 1857, p. 43) does not seem to be inclined to separate these forms from *Tritonium (Triton)* at all; and Adams, Chenu, and others placed the genus under the *Buccinidæ*, next to *Phos*, Montf. H. and A. Adams refer (loc. cit. p. 127) to some distinctions in the animals between *Nassaria* and *Tritonium*, but certainly on comparing these with the animals of most of the *Buccinidæ*, it may be seen that the dilated foot, the placing of the eyes, and the straight siphon are far more like in the *Tritonidæ* than is generally the case in species of the *Buccinidæ*. The shell from its consistency and ornamentation is decidedly that of a *Tritonium* and

* Mörch (Proceed. Zool. Soc. Lond., 1862, p. 227) says 'the first species is *Nassa lyrata*, Gmel., p. 3794; Mart. IV, Figs. 1122–1123. If the quotation of Gmelin is right, the type is *Mangelia*; but if Martinis' figures are correct, the type is *Bucc. niveum*, Gmel. The latter, however, is not probable; and therefore the name *Nassaria* must not be used for *Hindsia*, H. and A. Adams.'

not of a *Buccinum*, or even *Phos*; and the same applies to the form of the operculum. *Hindsia*, or *Nassaria*, as stated by Adams, forms a small group of very characteristic shells, to which, however, species as *Canth. biliratus*, *pastinaca*, *nigricostatus*, and a few others classed by Adams under *Tritonidea* (Gen. I, p. 85), ought to be added. On the whole, I believe that it is absolutely necessary to form a generic distinction for these shells, but not to separate them from the other TRITONIIDÆ. For the study of the fossil species this genus is very important; there are numerous shells belonging to it described from tertiary beds under *Murex* and *Fusus*, and some of the cretaceous species of *Tritonium* and others appear to belong also to it, as I shall presently mention more in detail.

The fossil forms of the family TRITONIIDÆ do not seem to exhibit any marked generic distinctions from the living, at least I am not acquainted with a single one which would necessitate the formation of a separate group or even a sub-genus. It is therefore easier to classify the recent shells, as the state of preservation cannot here interfere. The present difficulty in coming to a conclusive arrangement is only the want of specimens in different stages of growth, as is especially required in *Tritonium* and *Apollon*.

The tertiary species belong mostly to *Lampas*, *Apollon*, *Simplum*, and a few eocene to *Epidromus*. The number of these tertiary species is comparatively a large one. Of cretaceous species only a few are recorded, but the state of preservation scarcely allows of a very close determination.

1.—*Tritonium urgonense*, Pict. et Camp. (Mat. p. l. Pal. Suisse, 3me. ser., 2me. pte. p. 662, Pl. 96, Fig. 3, and p. 663), would appear to belong to *Tritonium* (as restricted). Pictet compares its generic identity with *Tritonium fusiforme*, Kiener, which, at least in its predominant characters, belongs to this genus.

2.—*Tritonium cretaceum*, Müller (Pet. Aach. Kreidef., 1851, II, p. 47, Pl. 5, Fig. 2). Although Müller (p. 48) says that the species occurs 'in best preservation' in the 'Grünsand' near Vaelsbrug, the representation which he gives certainly does not appear to be that of a perfectly preserved specimen. In no other genus, save *Epidromus*, do the varices appear so oblique as to cross the other transverse ribs, and the species if perfect can therefore only belong to this; otherwise any body might be misled to see in it only the upper portion of the shell of a species of the ALATA.

3.—*Tritonium Koninckı*, Binkh. (Gast. et Ceph. Limbourg, 1861, I, p. 4, Pl. 1, Fig. 10) has externally the varices not well distinguished, and from the impressions of teeth on the inner margin of the outer lip it would appear to be a *Tritonium*.

4.—*Tritonium Gosauicum*, Zekeli, 1852 (*vide* Sitz. Akad. Wien, 1865, LII, Revs. etc. p. 80, Pl. 1, Fig. 4), is a *Simplum*, known from the aperture in good preservation.

5–8.—*Tritonium Hornii*, *Diegoensis*, *paucivaricatum* and *Whitneyi* have been described by Gabb from the cretaceous beds of California (Pal. 1864, I, pp. 94—96). None of the species was found with the aperture well preserved; the three first named would seem to be *Tritonium* proper, although the shells in general very much resemble some species of *Leiodomus*, Swainson, which with *Adinus* of Adams are

quoted by H. and A. Adams (Gen. I, p. 114) as sub-genera of *Pseudostrombus*, Klein (*Dorsanum*, Gray). It is by no means certain that these two generic groups do not belong to the *Tritoniidæ*. I should say, judging from figures only, that the ornamentation and the form of the aperture would rather be in favor of such a transfer. The last of Gabb's species may be possibly a *Hindsia*, if not a *Tritonidea* of the *fusinæ*.

9–12.—*Tritonium gravidum*, *Lagena nodulosa* and *secans*, and *Hindsia eximia* are four species from the South Indian cretaceous rocks. The descriptions of these are given below.

To these have to be added probably the following:—

Triton atavus, Forbes (Trans. Geol. Soc. Lond. VII, p. 126, Pl. 13, Fig. 14). I have not been able to trace this species, and until other specimens have been procured, Forbes' name must be retained. Certainly the species is not a *Fusus*, to which all subsequent writers following D'Orbigny refer the same, but in all probability is a true *Tritonium*.

Triton? elegans, Desh. (Mem. Soc. Géol. France, 1842, V., pt. I, p. 14, Pl. 17, Fig. 13, *Fusus id.* D'Orb.) is probably a *Hindsia*, so far at least as the exterior character of ornamentation is concerned, and very much the same appears to be the case with

Fusus Gaultinus, D'Orbigny (Pal. Franç. Crét. II, p. 335, Pl. 223, Fig. 1); *Fusus Vibrayeanus*, D'Orb. (*ibid*, Pl. 223, Fig. 6); *Buccinum cancellatum*, Alth. (Haidinger's Abhandlungen, 1850, III, p. 224, Pl. 11, Fig. 25), from the cretaceous deposits near Lemberg in Galizia; and *Fusus pedernalis*, Römer (Kreidebildg. Texas, 1852, p. 38, Pl. 4, Fig. 13), will probably be shown to belong to *Hindsia* also. The figured specimens seem to have been all in tolerably good preservation, and the point of difference could be very easily settled by an inspection of the originals.

The following so called species have to be excluded from the family *Tritonidæ*: *Tritonium crebriforme*, Zek. (*vide* Stoliczka in Sitz. Akad. Wien, 1865, LII, Revis. p. 80) being only a fragmentary specimen of a *Cerithium*; *Tritonium loricatum*, Zek. (Gosau Gasterop. 1852, p. 83, Pl. 15, Fig. 3; Stoliczka, loc. cit. p. 80). This species has been transferred by me to *Murex*, and as the specimen figured by Zekeli is a perfect one, it appears tolerably certain that the species belongs at least to the sub-family *muricinæ*, although it is difficult to determine the genus strictly. Were the outer lip thickened by a varix, it might be justly referred to *Hindsia*, but in such a case the single known specimen could be only in a transitory state of growth.

Summarizing the above notes we may say, that there are at present 12 species of cretaceous *Tritonidæ* known as certain, divided into equal numbers of four, from Europe, from North America, and from India. Five species more, *viz.*, three from Europe, one from North America, and one from India, are somewhat doubtful, but most probably belong to this family. Of all the species yet found in the cretaceous deposit, not one belongs to the forms commonly known under the generic name

of *Ranella*, and only one belongs to *Simplum*, another perhaps to *Epidromus*, and the rest either to *Tritonium* or *Hindsia*, both genera respectively fewer in number as represented among living shells.

XXXI. HINDSIA, *Adams*, 1850.

1. Hindsia eximia, *Stoliczka*. Pl. XI, Figs. 15—17.

Hinds. testa ovate elongata; spira ultimo anfractui æquali seu paulum breviori; anfractibus senis, convexis, primis duobus lævigatis mamillatisque, ceteris transversim costatis, spiraliter costulato-striatis; costis 10-12 *in uno circuitu, parum curvatis, æqualibus; striis fortioribus, in ultimo numerosis, omninis in costis transversalibus subtuberculatis atque in interstitiis una vel duabus striis tenuioribus ornatis; apertura rotundata, antice elongata; marginibus intus crenulatis; labro incrassato, varici-formi; canali moderate prolongato, lateraliter atque suprá recurvo; basi antice obsolete-fissurata.*

Spiral angle 60°-70°; sutural angle 6°.
Height of last whorl : total of shell (considered as 1·00) ... 0·63—0·52.

The height of the spire is somewhat variable; being in some specimens, which are more inflated, somewhat shorter than, in others about equal to, the height of the last volution. The ornamentation is very characteristic, and in no way different from that in living species of the same genus. The whorls are more contracted above or posteriorly than below, and are crossed by 10 to 12 equally strong, transverse ribs, and usually four or five strong spiral striæ, which on reaching the former are elevated into more or less sharpened tubercles. The two uppermost striæ are with respect to the others a little thinner, the next lower somewhat more elevated than the following two, in addition to which occasionally a sixth one is apparent on the suture of the penultimate whorl. On the last volution these stronger striæ are by far more numerous, covering the entire anterior portion, and between all of them there appear gradually, with the growth of the shell, one or two finer striæ.

The aperture is roundish, and anteriorly narrowly prolonged with the margins all round crenulated or obsoletely plicated. The outer lip is thickened, forming exteriorly a thick varix; the inner lip is also thickened, leaving a slight fissure visible near the anterior extremity; this latter is recurved laterally, and somewhat upwards, the margin of the inner lip, where the columella terminates, is as usual sharp.

In the specimens figured on Pl. XI it will be observed that the small tubercles on the transverse ribs become fully developed only after the specimen reached a certain size. In this stage of growth the species recalls very much the ornamentation of *Fusus Gaultinus*, D'Orb. (figured Pal. Franç. Crét. Pl. 223, Fig. 1, by mistake under the name of *F. rusticus*, Fitton). In young specimens of *H. eximia* the spiral striæ are, however, more uniform in thickness, and more closely placed to each other; at the same time the finer intermediate striæ are almost totally wanting.

Localities.—Comarapolliam, Arrialoor and near Vylapaudy, in the Trichinopoly district; not common.

Formation.—Arrialoor group.

XXXII. TRITONIUM, *Link*, 1807.

1. Tritonium gravidum, *Stoliczka*. Pl. XI, Fig. 14.

Trit. testa ovate elongata, turrita; anfractibus septenis, ad suturas planiusculis, et angustatis, supra medium angulatis, infra lente convexis, transversim costulatis, spiraliter striatis, costulis atque striis supra medium multo tenuioribus; margine suturali posteriori tumescente et obsolete crenulato; infra medium striis spiralibus ternis fortioribus atque in costis transversalibus spinulose tuberculatis conspicuis, numerosis minoribus striis alternantibus; varicibus crassis, posterius spinose angulatis, in circuitu anfractuum $\frac{2}{3}$ distantibus; apertura subrotundata; labro extus moderate crasso, intus ad marginem sulcoso; labio lamelliformi, lævigato, postice unidentato, medio arcuato, antice crenulato; canali brevi, lateraliter curvo; columella ad terminationem anteriorem obsolete fissurata.

Spiral angle 65°; sutural angle 6°.
Height of last whorl : total of shell (considered as 1·00) ... 0·52.

An ovate shell consisting of about seven volutions, the last of which is very nearly of the same height as the spire. Each of the whorls is posteriorly much narrower and flattened, angulated a little above the middle and then slightly convex. The posterior edge along the suture is somewhat thickened and obsoletely granulated. The transverse ribs are from 14 to 16 in number in each volution, but they are very variable in strength in the different specimens; on the flattened portion of the whorls they always become thinner, although they never seem to disappear totally. The anterior portion of each of the upper whorls is ornamented with usually three strong spiral striæ, which, in crossing the transverse ribs, form small spinulose tuberculations. On the last whorl these spiral striæ are of course much more numerous, and the transverse ribs become towards the anterior extremity only very gradually obsolete. The interstices between the stronger striæ and all the flattened posterior or upper part of the whorls is covered densely with a much finer striation. The varices are very distinctly marked, often ornamented with sharpened tubercles, and distant from each other two-thirds of the circuit of each whorl. The aperture is roundish; the outer lip thickened externally and grooved internally; the inner lip provided posteriorly with a prolonged tooth, in the middle smooth and anteriorly partially crenulated; it is rather thin, lamellar, as is usually the case in typical *Tritonium*, not so enormously thickened as in *Simplum*. The canal is short and slightly bent to one side and a little upwards. The anterior margin of the inner lip being somewhat raised above the surface a slight fissure is formed on the columella.

Our Indian fossil recalls, as regards the general character or ornamentation, the *Tritonium Urgonense*, Pict. et Camp. (Mater. p. l. Pal. Suisse, 3me. ser. p. 662, Pl. 96, Fig. 3), which, although determined from a much smaller and imperfect specimen, differs evidently by the coarser and less numerous transverse ribs, and by having four stronger spiral striæ on each of the upper whorls. It belongs, however, most probably to the same group of the *Tritonidæ*.

Locality.—From a light coloured sandstone S. of Arrialoor; rare.

Formation.—Arrialoor group.

XXXIII. LAGENA, *Klein*, 1753.

I am not acquainted with any known cretaceous species, which could be properly attributed to this genus; and those two noted here from the South Indian cretaceous deposits stand, as regards their specific characters, almost perfectly isolated among cretaceous fossils.

1. Lagena nodulosa, *Stoliczka*. Pl. XI, Fig. 18.

Lag. testa ovate elongata, tenui; anfractibus quinis, primis mamillatis lævigatisque, ceteris ad medium acute-angulatis atque nodulosis, ultimo inflato tricarinato, carina superiori subnodulosa, carinis duabus inferioribus sublævigatis, tenuioribus; superficie spiraliter striata; apertura late angulata; labio lævi, postice plicosedentato; labro extus varicoso, intus late sulcoso; canali lateraliter moderate curvo.

Spiral angle 65°; sutural angle 10°.
Height of last whorl including the canal : total of shell (considered as 1·00) ... ... 0·64.

In general form this species recalls very much *Tritonidea* and similar *fusinæ*, but the large varix, which forms the outer lip of the aperture, indicates immediately its great relationship to other *Tritoniidæ*. The shell consists usually of about five volutions, the embryonal of which are smooth and somewhat enlarged. The spire is only a little shorter than the height of the last volution. The posterior portion of the upper whorls is much contracted, either flat or somewhat excavated and separated from the anterior perpendicular half of the whorls by a sharp numerously tuberculated keel. The tubercles are depressed both above and below, and their number amounts on the preceding whorl to about 12; often it is rather less than more. On the last whorl two additional keels appear below the principal one, but they do not usually exhibit any tuberculation.

The entire surface of the shell is besides covered with fine striæ of growth and a dense spiral striation, among which generally only one line below the tuberculated keel predominates a little in strength.

The aperture is much enlarged, angular with sharp raised margins, and internally quite smooth, with the exception of an elongated tooth on the posterior portion of the inner lip. The canal seems to be somewhat more elongated than usual in living species of this genus, and is bent slightly towards the left side (in front view).

Localities.—Near Shutanure, Veraghoor, Vylapaudy and Arrialoor, in the Trichinopoly District; not common.

Formations.—Trichinopoly-and Arrialoor-groups; to the latter the two last mentioned localities refer. The specimens from the two series of beds are all exactly alike, and offer no object of remark.

2. Lagena secans, *Stoliczka*. Pl. XI, Fig. 19.

Lag. testa ovate elongata, turrita, tenui; anfractibus ad medium acutissime carinatis, ultimo bicarinato; superficie spiraliter striata; apertura?—labio lævi; postice plicose dentato.

Spiral angle 55°; sutural angle 6°—7°.

This species, although not very rare, has not yet been procured in a desirable state of preservation, but its similarity to the preceding cannot leave a single doubt that it belongs to the same genus; in both, the structure of the shell is exactly alike.

It differs from *L. nodulosa* in having the keel of the upper whorls sharper, devoid of any distinct tuberculations, and only one additional keel on the last whorl. The outer joins the inner lip on the upper keel, while in *L. nodulosa* the aperture does not reach higher than to the median keel. The shell surface exhibits no farther ornamentation than a fine spiral striation and equally fine striæ of growth. Fragments of the upper whorls of specimens with not well preserved shell surface are much like *Trichotropis (Turbo) Koninckı*, Müll. sp.

Localities.—Olapaudy, W. of Arrialoor, and S. W. of Mulloor, in the Trichinopoly district.

Formation.—Arrialoor group.

XII. *Family,—COLUMBELLIDÆ.*

This family embraces a small number of genera, which agree in the *ovate or elongated form of a rather solid shell, a very short anterior canal, often replaced by an emergination of the anterior extremity only, and crenulated or plaited margins of the aperture, which is very often much narrowed by the thickening of the lips, specially of the outer one.*

Dr. F. Rolle published in 1861 some very able notes (Sitzungsb. Akad. Wien., Vol. XLII, p. 261, &c.) on the different types of *Columbella* (*sensu* Lamarcki) which occur living and neogene, being represented in the cretaceous period by *Columbellina*, D'Orb. and in the upper jurassic strata by the genus *Columbellaria*, Rolle (the typical species being *Col. corallina*, Quenst. sp., *Cassis* idem, Quenst.); it will be sufficient to refer here to these valuable observations. The living *Columbellæ* have been divided by Bellardi and others into different sections, according to the varying form of the shells. Gray, Adams and others accept a certain number of genera and sub-genera, and there can be no question that this system ought to be carried out; but great difference of opinion still exists as to the limits of these divisions, and they ought to be brought probably more into accordance with the apparently artificial classification of Bellardi. It does not seem likely that any other separation will practically succeed, than one based chiefly on the principal variations in the form of the shell, otherwise we must still increase the number of the sub-genera, which are quoted by Chenu and others. No less difference

exists as to the classification of the family *Columbellidæ* among the Prosobranchia. H. and A. Adams admit it as a sub-family of the *Mitridæ*, but for this the constitution of the shell does not seem to give any support. (*Vide* our family *Volutidæ*, p. 75). Gray places it next to *Nassa* in the *Muricidæ* only on account of having the nucleus of the operculum apical, while his *Buccinidæ* have the same lateral. The animals of the *Columbellidæ* are rather more like those of *Eburna* and *Cominella* than of *Buccinum*, but they have, on the other hand, nearly as much resemblance to those of *Persicula* and other *Marginellidæ*.

Deshayes classifies, as I have already stated, *Columbella* in the family *Volutidæ*, for which I do not see a sufficient reason. It is well known that a number of the living species described by different authors as *Columbella* belong properly to the *mitrinæ* or *purpurinæ (Ricinula)*, and when all these have been separated the family will form a pretty well characterised group. It appears, therefore, to us most advisable to regard, with Chenu, the *Columbellidæ* as a separate family, and I place it here because the fossil forms indicate evidently a transition between the *Muricidæ* and *Tritonidæ* on one and the *Buccinidæ* and *Purpuridæ* on the other side. The few known cretaceous species of the family belong without exception to

XXXIV. COLUMBELLINA, *D'Orbigny*, 1843.

Through the long posterior canal the cretaceous forms are most nearly allied to some tropical living forms, as *C. mercatoria, harpæformis* and others. Pictet (Pal. Suisse. Foss. Ste. Croix, p. 671) enumerates seven species; of these the two Indian *Pugnellus* must be excluded (*vide* our family *Alata*, p. 18), and we notice in their place another species, which appears to be a true *Columbellina*. The specimen, which was found in the Ootatoor group near Odium, is as yet unique, and is represented in Fig. 1 on Pl. XII. It being impossible to form the slightest conjecture as to the details of ornamentation of the shell surface, we prefer not to name this cast specifically. There do not seem to have been any strong ribs or tubercles present, because there is no trace of them left on the cast, but still, the shell having been evidently very thick, its surface may have been very richly ornamented. The anterior and posterior canals and the dentition on the middle parts of the outer and inner lips, as well as the interior shape of the aperture, are very distinctly marked.

The great interest which is attached to the Indian species is its occurrence among the few as yet known Gastropoda from the Ootatoor group, and I would therefore direct the special attention of any subsequent visitor to those places to this interesting fossil.

The number of known *Columbellinæ* from cretaceous beds is therefore to be reduced to six species, if actually the *Col. brevis*, P. and C. and *Col. neocomiensis*, D'Orb. sp. are different, and if the Indian species is distinct from those already known; its form recalls no doubt strongly that of *Col. monodactylus*, Desh. sp., but until the shell surface of the former is known, no support whatever can be given to these suggestions.

XIII. *Family,—BUCCINIDÆ.*

Buccinidæ and Cyclopsidæ, Chenu; buccininæ and nassinæ of Buccinidæ, H. and A. Adams; cominellina, nassina, phosina of Muricidæ and buccininæ of Buccinidæ, Gray).

In the separation of the *Buccinidæ* from the *Purpuridæ* we intend to follow Chenu, but we do not think that there exists any necessity to distinguish the *Cyclopsidæ*, certainly not as an independent family, for there is actually not the slightest reason to be found in support of a separation of *Cyclops*, Montf., from the *nassinæ*, as I will mention subsequently.

The animals of the *Buccinidæ* have a distinct, truncate head, the tentacles of moderate length, with the eyes on their outer side sessile: the eye-peduncles being represented only by small bulgings, or somewhat produced and united with the tentacles; the proboscis usually long; the teeth in three series, the central being broad and fixed, the lateral versatile; mantle enclosed; siphon usually recurved; foot simple, truncate in front, laterally waved and posteriorly always terminating in one or two points more or less produced.

The operculum is annular, but varying in size, form, and the place of its nucleus, according to the different sub-families.

The shells are mostly conically ovate, to a great extent smooth, and, if the whorls are ribbed transversally, the ribs are never unequal in strength; the canal is either very short or in most cases reduced to a deep notch, and the inner lip of the aperture is either smooth or dentate on the inner projecting margin only, but never folded.

According to the different prevalent shapes of the shell and the form of the operculum, four sub-families were distinguished, especially by Gray. With regard to their relations to the *Tritoniidæ* and *Columbellidæ* on the one side, and the *Purpuridæ* on the other, they may be quoted as follows:—

a. *Sub-family—PHOSINÆ* (Gray, Guide, 1857, p. 17).

Genera; 1. *Phos*, Montfort., 1810.
2. *Northia*, Gray, 1847.
3. *Cyllene*, Gray, 1833.

b. *Sub-family—NASSINÆ* (Gray, l. c. p. 16).

Genera; 1. *Desmoulea*, Gray, 1847.
2. *Cyclops*, Montf., 1810 (*Neritula* apud Adams, l. cit. p. 122).
3. *Nassa*, Lamarck, 1799.
4. *Bullia*, Gray, 1835, probably including *Pseudostrombus*, Adams, but excluding *Leiodomus* (in parte) and *Adinus*, forming separate genera, either here or in the *Tritoniidæ*. *Buccinanops*, D'Orb., could be retained as a good genus.

Chenu (Man. I, p. 164) formed for *Cyclops*, Montf. and *Teinostoma*, H. and A. Adams (Genera, I, p. 122), a separate family, *Cyclopsidæ*, which certainly must be

cancelled.* Gray (Guide, 1857, p. 17) does not separate *Cyclops* from *Nassa* at all, while other writers think the *Cy. neriteus* is only an abnormal form of some other species of *Nassa*. Chenu obtained a new species of *Cyclops* from the Crimean sea, *Cy. kamiesch* (*vide* Manuel, p. 165), which in general form agrees with the other Mediterranean species, but neither the animal nor the operculum has been made known of this second species. Comparing the animal of *Cyclops neriteus* with that of *Nassa*, it must be agreed that they are, strictly speaking, perfectly identical, and that the opercula of both are very similar, or at least not more different than in other forms of the so-called sub-genera of *Nassa*. The only difference exists in the form of the shell, and in comparing this, for instance, with species of the sub-genus *Auricularia* (Adams' Gen. I, p. 118), we meet forms evidently indicating a passage to *Cyclops*, differing from it almost solely by the short transverse ribbings. It appears quite sufficient to retain *Cyclops* as generically distinct from *Nassa*, but at the same time certainly to retain both in one sub-family. Fossil species, like *Nassa gibbosula* and a few others of upper tertiary age, belong to *Cyclops*. *Teinostoma*, Adams (Gen. II, p. 615), is justly referred to the *Rotellidæ* of Gray (*umboniinæ*, Adams), and I believe the jurassic fossil species like *Trochus Moreanus*, D'Orb., or the species of *Helicocryptus* are most nearly related to it. The family *Rotellidæ* has many more fossil than recent representatives, and some of the oldest known Gastropoda belong to it, but they are as yet dispersed under all the genera of *Trochidæ*; only comparatively few have been described as *Rotellæ*, some even as *Delphinulæ*.

Regarding the numerous sub-genera of *Nassa* quoted by Adams, it is difficult to form an idea as to their relative value, and so long as they are not supported by the examination of the respective animals, they must be looked upon merely as convenient sections or divisions of Nassa. It must, however, be granted that forms like *Zaphon* (=*?Aciculina*, H. and A. Adams, 1853, non *id.* Deshayes, 1864), *Uzita*, *Naythia*, and others ought to be generically separated, although it will be difficult to follow these and other divisions in fossil Conchology, but probably only because the number of the fossil species as yet known is comparatively very small. The jurassic genus *Purpurina*, D'Orb., is generally referred by French authors to the family *Buccinidæ*, but there is not much support to be found for this classification in the formation of the shell. We shall mention the genus again in the family *Trichotropidæ*.

c. *Sub-family.—COMINELLINÆ* (Gray, Guide, 1857, p. 15).

Genera; 1. *Cominella*, Gray, 1847.
2. *Truncaria*, Adams and Reeve, 1848.
3. *Eburna*, Lamarck, 1801.

* Chenu, as seen from several other instances, does not appear to have noticed Adams' Appendix, pp. 614-648, at the end of the IInd Volume. There are several very important and valuable additions and corrections to be found in it.

d. *Sub-family—BUCCININÆ,* Gray (loc. cit. p. 21).

Genera; 1. *Buccinum,** Linn., 1767.

2. *Pseudoliva,* Swains. 1840 *(Gastridium,* Sow.; *Gastridia,* in Gray's Guide; *Sulcobuccinum,* D'Orb., 1850, Prod. II, p. 303).

The shells of fossil and recent *Pseudolivæ* agree in general form rather more with *Buccinum* than with *Purpura,* with the latter of which the genus has been associated by H. and A. Adams and Chenu.

3. *Buccinopsis,* Conrad, 1857, and

4. *Pseudobuccinum,* Meek and Hayden, 1857.

These two genera are founded upon two species from the cretaceous beds of North America, and they appear to resemble in general form *Buccinum* and *Pseudoliva.*

5. *Haydenia,* Gabb, 1864 (Pal. Calif. I, p. 98), is allied to *Pseudoliva,* and probably best classed here. Its general form and anterior canal recall some species of the *PURPURIDÆ.*

Species which can with sufficient certainty be said to belong to the family *BUCCINIDÆ* are not known from any beds lower than the jurassic, if we refer to it the *Buccinum? oolithicum,* Heb. and Desl. (Bull. Soc. Linnè. Norm. 1860, V, p. 173, Pl. VII, Fig. 14) from Montreuil-Bellay. The species appears to belong to the *PHOSINÆ* or *NASSINÆ,* although there are no living forms known, which have the anterior termination of the aperture and the last whorl so much produced and so slightly notched. It could quite as well form the type of a new genus.

The *Buc. bidentatum,* Buvignier (Stat. de la Meuse, p. 45, Pl. 29, Figs. 14—16) from the coral-rag can be quite as well a species of the *CERITHIIDÆ* or *LITTORINIDÆ.*

The *Buc. angulatum,* Sow. (Trans. Geol. Soc. Lond., ser. II, Vol. IV, p. 347, Pl. XXIII, Fig. 5) from the Portland-stone belongs to the family *ALATA (Aporrhais* or *Alaria),* and the *Buc. naticoide,* Sow. (*ibid* Fig. 4) is said to be a *Natica.* The shell has very much the form of a *Pterodonta.* The *Buc. parvulum,* Röm., is perhaps identical with *Orthostoma Virdunensis* Buvign. (Stat. Meuse, Pl. XXXII Fig. 7), but the species looks rather more like a *Purpurina.*

Bucc. lævigatum, Piette, (Bull. Soc. Géol. France, 1856, XIII, p. 595, Pl. XV, Figs. 19 and 20) appears to be a true *Nassa,* or one of the sub-genera. The *Bucc. oliva,* Piette (*ibid* Figs. 17 and 18) is rather more like an incomplete *Cylindrites,* for when the outer lip in any of these forms is broken away, the anterior extremity seems to have terminated in a canal, while in reality this appearance is only caused by the twisted columella or the plaits on it, and the aperture has in its perfect state only the anterior portion of the lip somewhat produced, but not notched.

Cretaceous species are also very limited in number. From the eocene beds about 30 species are known up to the present, which number increases in the neogene period to about four times as many, and again trebles itself in the present time, as there are about 360 living species of *BUCCINIDÆ* known. Since the

* For several species, described by Reeve under *Buccinum,* as *B. cassidariæforme, B. signum,* and others, A. Adams proposes a new generic name *Siphonalia, vide* Ann. Mag. nat. hist. 1863, XI, p. 202; the shells are stated to have no epidermis, a short, recurved anterior canal, and are otherwise allied to *Neptunea;* the operculum is like that of the *FUSINÆ.*

restriction of the genera it has been found, that the smallest number of fossil species belong to *Buccinum* proper. There is scarcely one true *Buccinum* from the cretaceous beds, to which genus in general the species have been attributed. (*Vide* Mat. p. l. Pal. Suisse, 3me. ser. pt. ii, pp. 672 and 673). The following are the cretaceous species known up to the present time; most of them belong either to the sub-family *NASSINÆ* or *BUCCININÆ*:—

1. *Buccinum gaultinum*, D' Orb., is most probably a *Nassa*.
2. „ *rennense*, D'Arch., in all respects a very doubtful species.
3. „ *Steiningeri*, Müller, a *Nassa*.
4. „ *constrictum*, Hall and Meek, sp. (*Fusus id.* Am. Acad. Arts and Sc. Boston, v, p. 391, Pl. 3, Fig. 7) may be a *Nassa*.
5. —*Pseudobuccinum Nebrascense*, M. and H. (1857. Proc. Acad. Nat. Sc. Phil. p. 140).
6. —*Buccinopsis Parryi*, Conrad, 1857, Emory's Report, p. 158, Pl. 3, Fig. 4. I have not been as yet able to procure this publication, and quote the species on Mr. Gabb's authority (*vide* Proc. Am. Phil. Soc. VIII, 1861, p. 97).
7. —*Nassa lineata*, Sow., 1836 (*Buccinum pseudolineatum*, D'Orb.) is a true *Nassa*.
8. —*Buccinum supracretaceum*, Binkh., 1861 (Monogr. Gast. et. Ceph. de Limbourg, p. 12, Pl. l, Fig. 7) is apparently a *Nassa*, and related to *Nassa Arrialoorensis*, n. sp.
9. —*Buccinum liratum*, Gabb, 1864 (Pal. Calif. I, p. 26, Pl. 28, Fig. 211). The posterior lip is rather thickened, and it is possible that the species belongs to *Bullia*.
10-11. —*Nassa cretacea* and *antiquata*, Gabb, *ibid*, p. 97.
12. —*Haydenia impressa*, Gabb, *ibid* p. 98.
13-14. —*Pseudoliva lineata* and *volutæformis*, Gabb, *ibid*, p. 99.

To this we add from the South Indian cretaceous deposits three new species,

15-17. —*Nassa Vylapaudensis* and *Arrialoorensis*, and *Pseudoliva subcostata*.

To the species of *Buccinum*, quoted by Pictet and Campiche, as to be excluded, we would add, *Buc. cancellatum*, Alth, which appears to be a *Hindsia* (*vide* ante p. 10).

Nassa affinis, Sow., is not a *Cerithium*, as D'Orbigny suspected, but a *Rissoa* and remains *R. affinis* = *R. velata*, Zek.; *vide* Sitz. Akad. Wien, 1865, LII, Revis. etc., p. 19.

Nassa carinata, Sow.; it is not possible to trace this species without comparing the original fragment, although it most probably belongs to *Pterocera subtilis*, Zek. (Sitzungsb. Akad. Wien, 1865, LII, Revis. etc., p. 70).

Nassa costellata, Sow.; (Fitton in Trans. Geol. Soc. London., ser. II, Vol. IV, p. 344, Pl. XVIII, Fig. 26). D'Orbigny (Prod. II, p. 156) places this species under *Cerithium*, and apparently more correctly, for the remaining varices on the whorls, to which Sowerby refers in his description and figure, are quite foreign to species of the *BUCCINIDÆ*, but they do occur often among the *CERITHIIDÆ*, and especially among cretaceous forms, as *Cerithium reticosum*, Sow., *Cerith. furcatum*, Zek. and others.

Excluding thus the very doubtful species we may say, that there are up to the present 17 species of *BUCCINIDÆ* known from cretaceous rocks, five being European, nine North American, and three South Indian; but I suspect that, when all the forms described from the cretaceous beds of Europe under the name of *Cerithium* are better known, several species of *NASSINÆ* and *PHOSINÆ* will be found represented among them. The comparatively large number of North American species has increased only through the late addition of the successful Survey of California, and the careful examination of the fossils by W. Gabb. The three Indian species are noticed here for the first time, thus adding to the six or seven species of *Nassa* two more, and to the two North American species of *Pseudoliva* one. Compared with other fossils as regards their frequency of occurrence, the *BUCCINIDÆ* must be said to be very rare, and most of the species are known from single or a few specimens only.

XXXV. NASSA, *Lamarck*, 1799.

1. Nassa Vylapaudensis, *Stoliczka*. Pl. XII, Fig. 4.

N. testa conica, spira elongata ; anfractibus senis seu septenis, prope planis, suturis parum impressis sejunctis, transversim costulatis, in parte posteriori apud suturam 4-5 *striis spiralibus ornatis ; costulis obliquis, paulo arcuatis, interstitiis latioribus separatis, circiter* 20 *in uno circuitu ; ultimo anfractu ad basim subangulato ; basi spiraliter dense striata ; apertura*— ?

Spiral angle 40° ; sutural angle 8°.

Although the aperture is not quite perfectly preserved in any of our specimens, the general form of this shell is so characteristic, that it most probably belongs to this genus. It is most nearly allied to those species, which H. and A. Adams refer to the sub-genera *Zeuxis* and *Zaphon*.

The shell is conical, composed of six or seven nearly flat volutions, each of them being crossed by about 20 transverse ribs. These are slightly curved, oblique, and below the suture traversed by four or five spiral striæ, becoming gradually thinner as the distance from the sutural line increases. The base of the last volution is densely covered with spiral striæ also. The aperture has been restored in its probable shape from a second but otherwise more defective specimen. The columellar lip appears to have been partially thin, as the spiral striation is traceable on the posterior portion quite clearly, but the columella itself was quite solid.

This species bears a great resemblance to several tertiary forms of *Nassa*, but there is up to the present no cretaceous species known, which could be compared with our Indian fossil.

Locality.—Vylapaudy in Trichinopoly ; four specimens have been examined.

Formation.—Arrialoor group.

2. Nassa Arrialoorensis, *Stoliczka*. Pl. XII, Fig. 3.

N. testa conico-elongata ; anfractibus senis, convexis, suturis profundis sejunctis ; singulis postice ad suturam valde constrictis, spiraliter dense striatis, transversim costatis ; costis circiter denis in uno circuitu, obliquis, crassis, ad suturam abrupte tenuioribus atque subangulatis, antice in ultimo anfractu evanescentibus ; apertura ovali ; labio lævi, crasso, calloso.

Spiral angle about 40° ; sutural angle 11°.

It is with some doubt that I refer this species to *Nassa*, although it may belong to the section *Uzita* of Adams, as the edge of the columella along the canal is somewhat sharpened, not provided, however, with a fold. The great thickness of the inner lip, which is smooth internally, and the general form of the shell, makes it almost certain that the species has to be classed with the *Buccinidæ*. The only almost exceptional case, which could be expected when perfectly well preserved specimens of

this species are procured is, that the posterior constriction of the whorls along the suture may be connected with, and dependent on a slight insinuation of the outer lip, and in such a case the species would have to be transferred to *Mangelia* or *Clathurella* (*Defrancia*, Millet). I have not, however, been able to detect in our present specimens any curvation of the striæ of growth, which would indicate such a notch on the aperture. The spiral striæ are fine and cover the entire surface of the shell; their slight undulations are caused by the striæ of growth.

Buccinum supracretaceum, Binkhorst, quoted above, is the nearest and among cretaceous species the only ally of our Indian fossil. It differs, according to Binkhorst's figure, by the more uniform convexity of the whorls and by the transverse ribs being almost perpendicular to the direction of the sutural line.

Localities.—Vaitagoody and N. of Karapaudy, in Trichinopoly district. Only two specimens have as yet been examined; neither of them has the outer lip, nor the anterior extremity with the termination of the canal, perfectly preserved.

Formation.—Arrialoor group.

XXXVI. PSEUDOLIVA, *Swainson*, 1840.

1. Pseudoliva subcostata, *Stoliczka*. Pl. XII, Fig. 2.

Pseudol. testa ovata; spira ultimo anfractu breviore; anfractibus quinis, primis duobus lævigatis, ceteris transversim multicostatis; costis circiter 16 *in uno circuitu, parum obliquis, in ultimo anfractu infra medium evanescentibus; parte anteriori ultimi anfractus usque ad sulcum medianum spiraliter striata; sutura canaliculata; margine posteriori anfractuum terminatione costarum coronato; apertura ovali, postice acuta; labio lævi, calloso, arcuato.*

Spiral angle 65°; sutural angle, 10°.

This pretty little shell is, although not perfectly preserved, well characterized by the numerous transverse ribs, which on the last whorl become obsolete about the middle of its height; they are slightly curved, and on the deeply canaliculated suture somewhat produced into sharpened points. Below the principal furrow, which is characteristic for the genus *Pseudoliva*, the anterior portion of the last whorl is finely, spirally striated, the rest of the surface being apparently smooth. The posterior part of the inner lip is thickened, and so far as visible internally quite smooth; the canal or rather the emargination of the anterior extremity is indicated by a slight swelling extending from the inner margin in a curve parallel to the principal furrow; the termination of the canal has not been, however, as yet observed.

Locality.—Niinnyoor; occurring in a white arenaceous limestone; only the figured specimen has as yet been procured.

Formation.—Arrialoor group.

XIV. *Family,—PURPURIDÆ.*

The animals of the *PURPURIDÆ* are in general much like those of the *BUCCINIDÆ* except that the foot does not terminate posteriorly in a separate process, and is in general stouter and more truncate; the tentacles are never very long, and the eye-pedicles unite with them, terminating at half the length of the former. The operculum is oblong, with an elongated nucleus at the *outer edge.*

The shell of the *PURPURIDÆ* is usually distinguished by the shortness of the spire and large size of the last whorl, being anteriorly either notched or produced into a canal; the inner lip is smooth, occasionally toothed posteriorly and anteriorly; it is always *somewhat flattened,* where the columella terminates, forming inside a more or less distinct edge. According to Gray (Guide, 1857, pp. 18—21) two sub-families may be easily separated, *PURPURINÆ* and *RAPANINÆ.*

I may mention beforehand that the classification of *Nisea, Leptoconchus, Melapium,* and *Separatista* is somewhat uncertain, and still more doubt can be entertained regarding *Pinaxia;* the genera themselves—except perhaps *Separatista,* which may rather belong to the *TRICHOTROPIDÆ*—require confirmation in many points, before they can be universally accepted and placed accordingly in the system. I shall therefore not include these doubtful genera in the present list, although the first three named, if otherwise correct, can scarcely be classed in any other family than this, the two former in the *PURPURINÆ,* the latter in the *RAPANINÆ.*

a. *Sub-family.—PURPURINÆ.**

Genera; 1. *Jopas,* H. and A. Adams, 1853 (Gen. I, p. 128).
2. *Vexilla,* Swainson, 1840 (*ibid* p. 129).
3. *Purpura,* Bruguiere, 1789 (*ibid* p. 126), with sub-genera, several of which may have generic value.
4. *Purpuroidea,* Lycett, 1848.
5. *Monoceros,* Lamarck, 1809 (*Acanthina* in H. and A. Adams', *Acanthiza* in Gray's Guide, 1857).
6. *Mitrella,* Risso, 1826 (?) (*vide* Adams' Gen. II, p. 620).
7. *Sistrum,* Montfort, 1810. (*ibid* Vol. I, p. 130).
8. *Ricinula,* Lamarck, 1812, if worthy of distinction from the former; *Pentadactylus,* Klein, apud H. and A. Adams, loc. cit. I, p. 129.
9. *Concholepas,* Lamarck, 1801. *Conchopatella,* apud H. and A. Adams, loc. cit. I, p. 132.
10. *Magilus,* Montfort, 1810. *Campulotus* apud H. and A. Adams, loc. cit. I, p. 138.

Except *Purpuroidea,* a genus established for a jurassic group of shells, undoubtedly allied to *Purpura (in parte),* there are no secondary species as yet known which may not be objected to as belonging to this sub-family. Of *Purpuroidea* itself only two cretaceous species have been reported: one of these occurs in the Alpine Gosau deposits, *P. Reussi,* Hörnes (Denksch. Akad. Wien, X, p. 177), but its

* *Purpurina,* D'Orb., belongs probably to the *TRICHOTROPIDÆ* (*vide* postea).

determination is not very certain. It is found with *POTAMIDINÆ*, certain species of *NATICIDÆ* and others, in at least partially brackish deposits, and it would not be very difficult to associate it with the *MELANOPSINÆ*. Gabb (Proc. Acad. Nat. Sc. Phil. 1860, p. 94, Pl. 2, Fig. 11), describes a *P. dubia*, but this is indeed more than doubtful, and judging from the figure, it can belong quite as well to any other even approximately allied genus.

Pictet (Mat. Pal. Suisse, 3me. Ser., p. 673), mentions from the Gault of Cosne an undescribed species which, he thinks, may belong to the *PURPURIDÆ*, but whether to this or the next sub-family is not yet known.

It is possible that the *Voluta corrugata*, Binkh. (Monog. Gast. et. Céph. craie de Limbg., 1861, p. 14, Pl. V, Fig. 1), is a *Purpura*, if no columellar plaits exist.

Buvignier (Statist. d. l. Meuse) describes some jurassic *Purpuræ;* but these had better be referred provisionally to *Purpuroidea*, until the relations of this genus to *Stramontia* and *Thalessa*, two forms of shells, quoted as sub-genera of *Purpura*, are satisfactorily settled. It would appear that all three ought to form one genus, apart from *Purpura* proper.

b. *Sub-family—RAPANINÆ.*

The shells of this sub-family are distinguished by a comparatively very short spire, rapid increase and ventricose form of the last whorl, being anteriorly produced into a shorter or longer, but always distinct canal. The inner lip is always strongly developed, often thickened, toothed posteriorly or wrinkled in front; the umbilicus remains usually uncovered, at least partially.

The genera which appear to be admissible in this group are as follow:—

1. *Cuma*, Humphrey, 1797.
2. *Litiaxis*, Swainson, 1840.
3. *Rapana*, Schumacher, 1817.
4. *Rhizochilus*, Steenstrup, 1850.
5. *Vitularia*, Swainson, 1840.
6. *Morea*, Conrad, 1860.
7. *Rapa*, Klein, 1753.
8. *Tudicla*, Bolten, 1798.
9. *Whitneya*, Gabb, 1864, Calif. Palæont. I, p. 103; reminds one more of *Melapium*, H. and A. Adams (Genera, I, p. 136).
10. *Chorus*, Gray, 1847.

For the secondary deposits this sub-family is by much more important than the previous. Scarcely any jurassic species are known with certainty, but the number of cretaceous is comparatively large. Most of them have been described under *Pyrula*, and Keferstein (in Bronn's Klassen und Ordnungen des Thierreiches, III, p. 1047) and others class in fact *Rapa*, *Rapana*, &c. with *Pyrula*, Lamarck, without acknowledging even a generic distinction. There is, however, not very much doubt now, that Lamarck's genus *Pyrula* cannot be retained, even when *Ficula* or *Sycotypus* have been separated, as proposed by Deshayes

and others. The same must be done with *Rapa* and other *Rapaninæ*, *Melongena*, *Hemifusus* and other *fusinæ*, and what then remains to be called *Pyrula*, I am not prepared to say, nor is the matter involved in any way in the present discussion of our cretaceous shells. Dr. J. Müller, in his 'Petrefacten d. Aachner Kreideform.' 1851, pp. 39 and 40, was one of the first who directed attention to the cretaceous forms belonging to *Tudicla (Pyrella)* and *Rapa*, as being different from *Murex* and *Pyrula* respectively.

Gabb has distinguished in his catalogue a few species of *Rapa* and others belonging to this sub-family. Pictet and Campiche referred them all summarily to *Fusus*, in a similar manner as they have done in another place with *Aporrhais*. We cannot agree with this kind of generic classification.

The following is a list of the species which have been made known from the cretaceous deposits, and which appear to belong to this sub-family; the names of the genera to which they show at least the nearest relation are noted in a parenthesis :—

European species.

1. *Rapa depressa*, Sow. sp., Gabb, Am. Ph. Soc. VIII, p. 130; *Pyrula* id. Sow. Trans. Geol. Soc. London, IV, p. 242, Pl. 18, Fig. 20—(may be a *Tudicla* or *Rapa*).

2. *Pyrula Brightii*, Sow., *ibid*, Pl. 18, Fig. 21; *Fusus id.* auctorum—(probably a *Rapa*).

3. *Fusus clathratus*, Sow., *ibid*, Pl. 18, Fig. 19; F. *subclathratus*, D'Orb. Prod. II, page 1551—(may be a *Rapa*, but the original specimen was very imperfect and nothing has been made known since).

4. *Pyrula planulata*, Nilss. Römer, Norddeutsch. Kreid., p. 78, Pl. 11, Fig. 11; *id.* Geinitz, Reuss.; *Pyrella id.* Müller, Petr. Aach. Kreidef. II, 1851, p. 39—(probably a *Tudicla*).

5. *Pyrula carinata*, *Römer*, N. Kreidef., p. 78, Pl. 11, Fig. 12—(? *Rapa*).

6. *Pyrula coronata*, Röm. N. Kreidef., p. 78, Pl. 11, Fig. 13; *idem* Geinitz and others; *Rapa id.* Müll. Petr. Aach. Kreidef. II, 1851, p. 40—(probably a *Rapa*).

7. *Pyrula costata*, Röm. N. Kreidf., p. 79, Pl. 11, Fig. 10—(? *Rapa*).

8. *Pyrula carinata*, Münst. Goldf. Pet. Germ. Gast. p. 27, Pl. 172, Fig. 11; *Fusus carinatulus*, D'Orb. Prod. II, p. 229; Kner, in Haidinger's Abhandlg. III, 1850, Pl. 4, Fig. 7—(may be a *Rapa*; the form in Goldfuss resembles rather a *Tudicla*).

9. *Pyrula sulcata*, Kner, in Haidinger's Abhandlg. III, 1850, p. 22, Pl. 4, Fig. 8; *Fusus Althii*, Kner, Denksch. Akad. Wien, 1852, Vol. III, Pt. II, p. 309, Pl. 16, Fig. 13—(probably a Rapa).

10. *Pyrella Benthiana*, Müller, Petr. Aach. Kreidef. II, 1851, p. 39, Pl. 6, Fig. 7—(perhaps a *Rapa*, but no sufficient evidence can be derived from the description or figure).

11. *Rapa Monheimi*, Müller, Petr. Aach. Kreidef. II, 1851, p. 40, Pl. 5, Figs 22 and 23—(the transverse ribs terminating below the suture in strong tubercles are of a form somewhat unusual in *Rapa* and more characteristic for *Hemifusus*; nothing about the umbilicus, or the flattened columella, is noticed in the description above referred to, but the species may remain provisionally as here classed, until a chance may occur of examining the specimens again).

12. *Pyrula filamentosa*, Binkhorst, Mon. Gastr. etc. Mæstricht, 1861, p. 7, Pl. II, Fig. 5—(may be a *Rapa*; *vide Rapa cancellata*, Sow. sp. 155).

13. *Pyrula tuberculosa*, Binkhorst, *ibid*, p. 8, Pl. 7, Fig. 5—(probably *Rapana*).

13. *Pyrula planissima*, Binkhorst, *ibid* p. 8, Pl. V^a, Fig. 3—(much resembling *Tudicla eximia*, n. sp. *vide* p. 151).

14. *Pyrula nodifera*, Binkh., ibid, p. 57, Pl. V,a 3, Fig. 11—(of a similar form to *P. filamentosa*, only with somewhat higher spire; but equally doubtful as to generic determination).

15. *Pyrula parvula*, Binkh., ibid, p. 67, Pl. Va 3, Fig. Ba b,—(perhaps a *Rapana*; at least the thickness of the columella, observable in Fig. Bb, makes it very probable that the species belongs to this sub-family).

16. *Pyrula? plicata*, Binkh., ibid, p. 68, Pl. V a 3, Fig. Aa b—(probably *Rapana*, belonging to those small forms similar to Adams' *Coralliophila*.*

17. *Pyrula subcarinata*, d'Arch. (Mem. Soc. Geol. France, II, Ser. II, Vol. p. 345, Pl. 25, Fig. 7), which D'Orbigny called in the Prodrome *Fusus Galathea*, is probably a *Tudicla*, certainly not a *Fusus*.

It is difficult to pronounce an opinion on the *Pyrula Smithii*, Sow. (Trans. Geol. Soc., London, Ser. II, Vol. IV, Pl. 11, Fig. 15). Sowerby already supposed, that he may have figured two species. Seeley (Ann. Mag. Nat. Hist. Ser. III, Vol. VII, p. 282), thinks that the Fig. 15a may belong to his *Pteroc. globulatum* (ibid, p. 281), and proposes for the species figured in 15b the name *Pyrula Sowerbii*. I would much rather believe that the species belongs to *Rapa* or to *Hemifusus*, than to *Ficula* = *Sycotypus* (*Pyrula* in parte).

African species.

18. *Pyrula cretacea*, Coquand, Paléont. Const. 1862, Pl. II, Fig. 12—(is a very doubtful cast, the general form and the indication of a laterally bent canal recall a *Rapa*).

American species.

19. *Rapa pyruloidea*, Gabb, Proc. Acad. Phil. 1860, p. 94, Pl. II, Fig. 4—(doubtful cast).

20. *Rapa supraplicata*, Conrad, Jour. Acad. N. Sc. Phil. III, 1858, p. 332, Pl. XXXV, Fig. 20—(equally doubtful).

21-22. *Pyrula (Fusus) longirostra*, et *P. Hombroniana*, d'Orb. Voy. Astrol. Paléont. 1847, pl. I. figs. 30-31; (belong most probably both to *Rapa*); the species are from Chili.

23. *Tudicla elevata*, Gabb, *Rapa idem*. Jour. Acad. N. Sc. Phil. II, Ser. IV, p. 301, Pl. XLVIII, Fig. 12.

24. *Tudicla perlata* (*Pyropsis* id.) Conrad, Jour. Acad. Nat. sc. Phil. II, Ser. IV, p. 288, Pl. XLVI, Fig. 39—(well preserved and typical form).

25. *Tudicla trochiformis*, Tuomey, sp. (Gabb, in Am. Phil. Soc. VIII, p. 141, states, that the former is probably identical with this species).†

26. *Morea cancellaria*, Conr. Jour. Acad. Nat. Sc. Phil. II, Ser. IV, p. 290, Pl. XLVI, Fig. 30.

27. *Morea naticella*, Gabb, ibid, p. 301, Pl. XLVIII, Fig. 15—(doubtful).

28. *Whitneya ficus*, Gabb, Pal. Calif. 1864, I, p. 104, Plate XXVIII, Fig. 216.

Indian species.

The following are described here from the South Indian cretaceous rocks.

29. *Tudicla eximia* n. sp.

30. *Rapa cancellata*, Sow., sp.

31. *Rapa nodifera*, n. sp.

32. *Rapa Andoorensis*, n. sp.

33. *Rapa corallina*, n. sp.

34. *Rapana tuberculosa*, n. sp.

We may safely state, that the Indian species are so far well preserved as to admit at least of a tolerably certain generic determination, and as regards the sub-family there can be no doubt whatever. This, however, is by no means so certain with reference

* *Pyrula ambigua* and *fusiformis*, Binkh., have rather the form of *FUSINÆ*.

† Meek. ('Check List of cretaceous invert. Foss. of N. America,' 1864, p. 23) refers *Busycon Bairdi*, and *Fusus Dakotensis*, to *Tudicla*.

to the other known species, which have been quoted. Excepting the *Tudicla perlata*, Conr. (prob. *T. trochiformis*, Tuom.), *Morea cancellaria*, Conr., *Whitneya ficus*, Gabb we may say, that there is not a single species the generic determination of which was unquestionable; the largest number of them being based upon imperfect cast specimens. The most probable are those described by Binkhorst from the Mæstricht Chalk and, so far as the sub-family is concerned, they cannot be very much doubted. But supposing the most unfavorable case, that only little more than one-half of the species, which we have quoted, are found correct, we have still a fair number of cretaceous *Rapaninæ*, amounting to 16 species, a number to which the tertiary species scarcely attain, showing thus the importance of the study of the *Purpuridæ* for the cretaceous deposits. It is remarkable, that scarcely any representatives of this sub-family are known from the cretaceous deposits of Southern Europe, while the species in the deposits of Northern Europe, as in England, Germany, Bohemia and Galicia, are by no means rare, even as regards individuals. The difference seems actually to exist, as it cannot be entirely due to a better and more extensive knowledge of the fossils of the northern cretaceous deposits. I never met with a species of this sub-family in the deposits of the Alpine Gosau formation, although I had repeatedly occasion to look over large collections from these beds, and to a great extent examined the same also in situ.

XXXVII. TUDICLA, *Bolten*, 1798.

Char. *Testa fusiformi, spira brevi; ultimo anfractu ventricoso, antice canali prolongato; apertura ovali seu rotundata, postice subcanaliculata; labio calloso, postice plicose-dentato, antice applanato, intus acute angulato atque plicam formante; columella late excavata.*

The posterior tooth on the inner lip and the anterior fold of the same may be considered as the principal distinction between *Tudicla* and *Rapa;* the length of the canal is probably also characteristic, and is well developed in Rapa *only* in younger specimens. The papillary apex must be excluded from the character, as it does not exist even in such typical forms as *Tudicla rustica*, Bast., which several conchologists up to the present time consider as identical with *T. spirilla.*

I adopt here Bolten's name, not because I would favor any ill-founded claim of priority against *Pyrella* or *Spirilla*, but because the name *Tudicla* is not likely to be so easily mistaken, and is in reality better known than any of the former, specially through Adams' and Chenu's conchological works, and because it has already become familiar in palæontological literature as well. It is quite the same in the case of this genus as with *Neptunea* of the *FUSINÆ* and many others.

Several conchologists may think it a novelty to find the genus classed here. I do not know more about the living shells than is stated in known conchological publications, and I have been led to the present placing of the genus in this sub-family merely by the very great resemblance of the form of the shell to that of

typical species of *Rapa*. This resemblance not only exists among the recent forms, but is rather more distinct in the fossil. In fact, when the posterior fold-like tooth, the anterior fold of the inner lip and the termination of the canal, are not well preserved or only somewhat obliterated, I do not know how to find it possible to distinguish these two genera. This resemblance appears to become greater the lower we descend in the age of the deposits, and it is the principal reason which I can produce in favor of the classification here adopted.

H. and A. Adams refer *Tudicla*,* to the family *Fasciolariidæ* and Chenu retains it in the same. Other conchologists class the few recent species either with *Pyrula* or *Murex*, and Gray in his last catalogue, 1857, p. 11, calls *Tudicla spirilla* an "unarmed Murex with rudimentary varices" "*(Pyrenella)*." There can be no question that the shell of *Tudicla* very much resembles a *Murex* (the genus, as restricted), but certainly the total want of varices is something very distinct; as regards that point the shell has evidently more relation to *Rapa*, which opinion seems to have been suggested already in 1851 by Dr. J. Müller. We cannot expect a final decision on this and other similar points until the animal and the operculum of *Tudicla* have been made known. The affinities to *Pyrula* must be dropped, and this the more, as there is scarcely anything for which the name *Pyrula* can be retained. The name itself will probably disappear after a little time from our conchological lists altogether. The cretaceous species belonging to this genus have been noticed previously; their total number amounts to about six.

1.—Tudicla eximia, *Stoliczka*. Pl. XII, Figs. 5-8.

Tud. testa spira brevissima; anfractibus quinis, ultimo maximo, ventricoso, prope suturam tumescente, postice lente excavato, antice applanato, ad peripheriam bicarinato; carina superna fortiori, nonnunquam obsolete-nodulosa (infra quam interdum carina altera, tenuior sita est); superficie lævigata seu distanter spiraliter striata; rostro antice (?) prolongato; apertura fere circulari, intus lævigata; labro ad marginem obsolete undulato; labio callosissimo; umbilico aperto.

The form of the shell seems so far pretty constant that the spire is never much elevated, and the last whorl embraces all the previous. There are at least two keels present on its periphery, the upper of which is stronger. Some specimens have only one keel below the two primaries, and a second anterior one indicated (Fig. 6); others have a keel below each of the primaries (Fig. 5). In large specimens (Fig. 7) the keels become almost obsolete towards the aperture, where the striæ of growth are much more strongly developed; these occasionally cause the appearance of slight tuberculations on the uppermost keel, and are always distinctly marked on the shell. The surface is besides sometimes covered with distant spiral striæ, which are very fine, but also disappear near the aperture.

* H. and A. Adams propose for two species *T. spinosa* and *armigera* a new generic name, *Tudicula*, which ought to be distinguished by spinous varices and three columellar plaits, and is most nearly allied to *Turbinella*. The form of the columella is not particularly alluded to, whether it is flattened or not, but from the existence of numerous columellar plaits it is likely to be different from that of *Tudicla* (*vide* Proc. Zool. Soc. 1853, p. 429).

The sutural margin of the last whorl is thickened, the upper portion slightly excavated, and naturally also the space between the keels on the periphery. The aperture is nearly circular, internally smooth; the posterior canal is distinct, and also the fold-like tooth near the same; the outer lip has a slightly undulating peristome the inner lip is very thick, with the anterior fold distinctly marked; the columella widely excavated and the canal produced, its margins approaching anteriorly very closely so as to leave only a narrow slit open. The anterior portion of the canal is not preserved in any of our specimens, but, to conclude from the remaining indications, it seems to have been somewhat contorted and laterally curved, as in *Tud. porphyrostoma*. Casts of this species are almost identical with *Pyrula planissima*, Binkhorst (Monograph. Gast. et. Céph. de Limbg., p. 8, Pl. V^a, Fig. 3), for which reason we have given a representation of a similar cast in Fig. 8); but who can vouch for the identity of these two fossils! According to Binkhorst's Fig. 3c, the European species seems to have the inner lip less thickened, especially near the posterior canal, and the whorls more evenly rounded in the circuit. Until better specimens are found of the Mæstricht fossil, nothing can be done save to keep both forms under separate names.

Localities.—N. E. of Karapaudy and near Arrialoor, in the Trichinopoly district; not rare.

Formation.—Arrialoor group.

XXXVIII.—RAPA, *Klein*, 1753.

Char. *Rapa testa pyriformi, spira brevi; ultimo anfractu ventricoso; antice canali prolongato; columella excavata; apertura subrotundata; labio lævigato, antice applanato, margine externo excavationem columellæ sæpius partim tegente.*

"*Rapa*," say H. and A. Adams in their Genera, I, p. 137, "differs from *Rapana* not only in the produced canal of the aperture and thin simple whorls, but in the free, reflexed inner lip and moderate umbilicus." The distinction indicated in the living *R. papyracea*, Lam., to which Chenu added the *R. tubulosa*, seems equally to exist in the fossil species, and it is therefore desirable that the same ought to be generically noticed, specially as the fossil forms seem to be by far the more numerous. A marked characteristic of *Rapa* seems to be throughout common, namely, that the anterior canal is proportionally much longer in young than in fully grown specimens of the same species. This is a well known fact in *Rapa papyracea*, and we have here occasion to exhibit it on the cretaceous *R. cancellata*, Sow. (compare the figures on Plates XII and XIII). It is probable that this distinction is valuable as regards *Tudicla*, in which such an alteration of form has not been observed.

The relation of the shell of *Rapa* to that of *Murex* is about the same as that of *Tudicla*; and from *Rapana* it differs in an equal degree, as *Cuma* from *Monoceros*.

The number of fossil and especially cretaceous forms belonging to *Rapa* seems to be very great, as has been noticed previously, but the usual want of the canal in the fossil state makes the determination very often uncertain.

1.—Rapa Andoorensis, *Stoliczka*. Pl. XII, Fig. 9.

Rap. testa ultimo anfractu ventricoso, ad peripheriam bicarinato, carina superna fortiori, nonnunquam subtuberculata; superficie spiraliter striata; striis alteris transversalibus incrementi æqualiter tenuibus interruptis, ultimis interdum sub-granulosis; spira parum elevata; apertura oblique quadrangulari, intus lævigata; labio moderate calloso, antice applanato, intus subangulato; columella aperta; canali prolongato, vix contorto?

The principal characteristics of this species consist in the two keels, the numerous spiral striation, increasing gradually in number according to the size and width of the whorls, the squarish and oblique shape of the aperture, and probably a comparatively lengthened canal. There cannot be a difficulty in distinguishing well preserved specimens from *Tudicla eximia*, n. sp., but in the case of imperfect specimens on both sides, it is almost impossible to succeed. The inner lip is much thinner than in *Tudicla eximia*, but has no posterior fold-like tooth, and is anteriorly distinctly flattened and internally angular, without forming, however, a distinct fold, as in *Tudicla*.

The striæ of growth are usually well marked, and on the upper flattened portion of the whorls bent in S-form; they produce occasionally a fine granulation on the spiral striæ, and on the upper keel even a kind of depressed tubercles.

Locality.—Andoor and Coonum, in the Trichinopoly District; very rare; one specimen is from Odium in the Ootatoor group, but being only a cast its determination is somewhat doubtful.

Formation.—Trichinopoly group.

2.—Rapa nodifera, *Stolizcka*, Pl. XII. Figs. 10 and 11.

R. testa ventricose-turbinata, spira brevi, anfractibus 3-4 *composita; ultimo anfractu ad peripheriam valde angulato, noduloso, postice lente excavato, spiraliter striato, liris granulosis cingulato, antice canali (?) extenso; apertura rotundate angulari, postice subcanaliculata, intus lævigata; labro ad marginem incrassato; labio tenui, antice applanato.*

This species is chiefly characterized by the strongly tuberculated keel, thin inner lip of the aperture, and apparently a rather more produced canal than in *Rapa cancellata*, Sow. The spire is short, composed of three or four volutions, all being slightly excavated above, covered with spiral striæ, and provided with small tubercles along both sutures. Below the principal keel there are one or two thinner keels or rather tuberculated ribs, and then again one stronger, being equivalent to the second keel of the former species; the rest of the shell is ornamented with spiral granulated striæ, somewhat thinner than the sulci separating them. Towards the margin of the aperture the striæ and tubercles mostly disappear. The posterior canal is distinct, the inner lip next to it somewhat thickened, but otherwise much thinner than in any of the other species. The excavation of the columella is partly covered, and the canal very narrowly open in front.

Locality.—Coonum, Andoor, S. of Serdamungalum, and Kolakonuttom, in the Trichinopoly group; not common.

Formation.—Trichinopoly group.

3.—Rapa cancellata, *Sowerby, sp.* Pl. XII, Figs. 12—16, & Pl. XIII, Figs. 1—4.

1846. *Pyrula cancellata*, Sow., Forbes, Trans. Geol. Soc. Lond., VII, p. 128, Pl. XV, Fig. 12.
1850. *Fusus Forbesianus*, D'Orb. Prodrome, II, p. 229; *idem* Pictet, Gabb., and others.

R. testa ventricosa; spira brevi; anfractibus quinis, postice applanatis seu lente excavatis; ultimo ad peripheriam bicarinato: carina superiori acuta, fortiori, inferiori nonnunquam obsoleta; canali contorto, aperturæ marginem exteriorem versus curvato; columella plus minusve excavata; superficie striis spiralibus granulosis ornata, nonnullis minoribus, alteris prope suturam atque in carinis fortioribus; apertura elongata; canali aperto; labio calloso, antice applanato; labro in ætate juniori tenui, ad marginem intus sulcato, in ætate provectiori incrassato, obsolete sulcato.

The form of this species is rather variable, as may be seen upon a view of the figures given on Plates XII and XIII. The spire of the shell is always very short, the last whorl ventricose, and above, like all the previous, flattened or even slightly excavated. On the periphery there are usually two keels present, the upper one being much stronger, and the lower becoming occasionally obsolete in more fully grown shells. The entire surface is covered with granulated spiral striæ, those near the suture and on the keels being much stronger. Sometimes the transverse ribbings form stronger tuberculations on the peripherical keels, while the other spiral striæ are comparatively much thinner.

The aperture is angularly elongated; the posterior canal is slight, but always distinctly marked. As in the typical, living, *Rapa papyracea* the anterior canal is in young specimens proportionally much longer than in old ones. It is not perfectly preserved in any of our numerous specimens, but in Fig. 12, Pl. XII, it is nearly complete. From this it was evidently somewhat contorted and bent back towards the outer margin of the aperture. The inner lip is considerably thickened, smooth, anteriorly flattened, covering with its margin the termination of the columella sometimes perfectly, or leaving it widely open. The outer margin is thin and internally sulcated in young specimens (Figs. 13 and 14, Pl. XII), while in full growth it is much thickened (Fig. 1, Pl. XIII).

The specimen figured by Forbes was no doubt partially a cast, and his description must have been derived from other better preserved individuals; the lower peripherical keel seems to have been not much developed, and on casts it is actually scarcely traceable. From some specimens in the Madras Museum there can be little doubt that Sowerby and Forbes had the fossil, as here specified, under consideration. It is one of the most common species, and tolerably well characteristic for the Trichinopoly group.

I could have added as a synonym of this species the *Pyrula filamentosa*, Binkhorst (Mon. Gast. et Céph. de Limbg., 1861, p. 7, Pl. II, Fig. 5) from the upper cretaceous deposits of Limbourg, if there was not a doubt about one all important point. A comparison, for instance, of Binkhorst's Figure with our Fig. 3 on Pl. XIII leaves actually no other specific distinction between the two, except that in our species the anterior portion of the inner lip is distinctly flattened, while in Binkhorst's figure there is even no trace of such a flattening. This is, however, in the determination of the genus so very important that in case the Mæstricht species does not actually possess that flattening, it must strictly be referred to the sub-family FUSINÆ, either to *Perissolax* or *Hemifusus*, although for my own part I would almost believe, that just at this point the fossil was not so well preserved as would seem desirable.

Localities.—Neighbourhood of Anapaudy and Andoor; N. of Alundanapooram; N. of Serdamungalum; W. of Kullygoody, Shutanure, Kolakonuttom, &c.

Formation.—Trichinopoly group; chiefly in light coloured sandstones all along the frontier towards the Arrialoor group.

4.—RAPA CORALLINA, *Stolizcka.* Pl. XIII, Fig. 5.

R. testa pyriformi, spira brevi, conica, acutiuscula; ultimo anfractu ventricoso, postice planiuscula, obsolete striato, margine suturali tumescente, supra medium angulato, obtuse carinato atque tuberculato, antice sulcis angustis spiralibus et distantibus notato, canali recurvo et contorto prolongato.

A small pear-shaped shell with a short pointed spire and a roundish last volution. Along the suture the margin of the whorls is somewhat thickened, below they are flattened, and then obtusely angulated and tuberculated. The greater portion of the last whorl is covered with spiral sulci which are much narrower than the striæ between them. The canal is tolerably long, contorted and somewhat recurved; the excavation of the columella only slightly indicated. Excepting fine striæ of growth there are no stronger transversal ribs.

This species is of all known cretaceous fossils most nearly related to *Fusus Tippana*, Conrad (Jour. Acad. Nat. Sc. Phil., Vol. IV, p. 286, Pl. 46, Fig. 41) from Mississippi and indeed so much so, that were it not for the stronger tubercles on the last whorls, and for the want of the thickened posterior sutural margin on the whorls, both could be easily identified. In fact, if it could be proved that the want of the ornamentation on the spire has been caused in the American species by an erosion of the surface, there would scarcely remain sufficient ground for not carrying out this identification.

Locality.—Ninnyoor; not rare; in a white sandy limestone with some CYPRÆIDÆ, VOLUTIDÆ, Corals, and other fossils. The species appears to be very characteristic for these coralline beds.

Formation.—Arrialoor group.

XXXIX.—RAPANA, *Schumacher*, 1817.

(Probably including CORALLIOPHILA, Adams).

Char. *Rapana, testa sub-pyriformi seu sub-globosa, crassa; spira brevi; ultimo anfractu ventricoso, antice canali brevi atque recurvo producto; terminatione columellari aperta.*

The distinction between *Rapana* and *Rapa* has been already referred to; it lies principally in the length of the canal of the latter genus. Gray (Guide, 1857, p. 19) says that *Rhizochilus*, Steenstrup, is a *Rapana* that lives on *Anthipathes*, and at certain periods of its life closes its shell with a calcareous secretion, and permanently fixes itself to the coral, where it eventually dies. As the species, known under the name of *Rhizochilus antipathicus*, Steenst. possesses, however, even in the young state a prolonged canal, which it afterwards closes perfectly, it may be, we believe, correctly separated under a special generic name, but there appears to be rather a doubt as to those species which H. and A. Adams consider a sub-genus of *Rhizochilus* and call *Coralliophila*. If in other ways the animals of *Coralliophila* do not exhibit any particular distinction, I think they cannot be viewed as any thing else but *Rapana* of small size living on corals, as already stated by Dr. Gray.

There is among our materials only one species, which we can refer to this genus; it is small, but when compared with specimens of *Rapa* of equal size, the shell is at least twice as thick. It has all the principal characters of the genus.

1.—RAPANA TUBERCULOSA, *Stoliczka*. Pl. XIII, Fig. 6.

Rap. testa globosa, crassa, spira brevissima; ultimo anfractu ventricoso, costis numerosis spiralibus, tuberculatis, sulcis profundis angustisque separatis ornato; apertura subrotundata, postice effusa; labro ad marginem undulato; labio calloso, postice dentato, ad medium arcuato atque transversim rugoso, antice applanato et interne angulato; columella ad terminationem excavata; canali breviore, angustissimo, recurvo.

Shell rather globose, consisting of about three volutions, the last of which envelopes the previous nearly completely, being strongly convex and inflated. The surface presents seven spiral ribs, provided with comparatively large tubercles and separated by narrow and deep sulci. The third rib from the suture is the strongest, forming a kind of keel. The aperture is roundish, posteriorly with a narrow canal; the outer lip has an undulating, sharpened margin; the inner lip is very thick, posteriorly toothed, in the middle cross-wrinkled, anteriorly flattened and internally angular. The canal is short, recurved towards the outer lip, opening in front with only a narrow slit. The columella is largely open and margined in front by the inner lip and backwards by the sharpened edge, which is produced by the anterior emargination of the canal. As regards ornamentation this species agrees markedly with *Morea cancellaria*, Conrad (Journ. Acad. Nat. Sc. Phil. IV, p. 290, Pl. XLVI, Fig. 30), but it is much more semi-globose,

broader and shorter than the American type. I must remark here that the above description has been taken from the single specimen, before it became unfortunately injured by dropping accidentally into a bottle with acid. It could not be saved until the surface had become rather corroded and polished in place of the tubercles, which, therefore, are only indicated in the representation on Pl. XIII, Fig. 6.

Locality.—Serdamungalum, in hard siliceous sandstone.

Formation.—Trichinopoly group.

XV. *Family—TRICHOTROPIDÆ.*

Vide Adams' Gen. I, p. 278; Gray's Guide, 1857, pp. 43 and 77, *VERENADÆ* and *Trichotropis*; Chenu's Man. I, p. 278.)

It will be sufficient to refer here to the above papers, in which the organization and the peculiarities of the animals of *Trichotropis* will be found treated at length.

Gray places *Trichotropis* in the family *APORRHAIDÆ* (sub-fam. *APORRHAINÆ*), for which scarcely any other reason than the similarity in the dentition can be given, although this appears to be by no means constant, as seen by a comparison of the teeth of *Trich. borealis* and *bicarinata*. Speaking of the *VERENADÆ* (=*Tricho. borealis*, l. cit. p. 43; *Verena* id. p. 44 - not *Verena*, Adams; *Tropiphora* id. p. 77), Gray says, "this family is the Buccinoid representative in this group," and comparing the animal with that of *Purpura*, or for instance of *Cominella* of the *BUCCINIDÆ*, the resemblance will be found far greater than at first sight it would appear. The operculum in form and position in the aperture is unquestionably more like the *BUCCINIDÆ* than *Aporrhais* or *Struthiolaria*. The shell appears in reality to form a transition between *Rapana* of the *PURPURIDÆ* and *Trigonostoma* of the *CANCELLARIIDÆ* and the place which has been assigned to the *TRICHOTROPIDÆ* by H. and A. Adams next to the last named family appears certainly the most probable to be correct. The tropical forms of *Trichotropis*, like *T. cancellata*, in their ornamentation resemble *Cancellaria* still more. Species of *Trigonostoma* would in fact be inseparable from *Trichotropis*, if they had no columellar plaits, so far as the form of shell is concerned, but its thickness may be said without exception to be greater in the former than in the latter genus, and if this could be considered of greater value than the want of columellar plaits, we cannot help confessing that the two species which we note under *Trichotropis* would have to be classed in the *CANCELLARIIDÆ*. It must, however, be remembered that the single lamellæ, which compose the shell of *Trich. Koninckii*,—the only species we can consult, the other one being imperfect and doubtful,—are quite as thin as in living species of *Trichotropis*, and that the thickness of the total shell is only produced by their overlapping each other.

Alora, Adams, 1861 (Proc. Zool. Soc. Lond. p. 272) has been proposed for an American species *(A. Gouldii)* with a very small umbilicus, and a produced, anteriorly non-canaliculated aperture. This character evidently recalls very much the form of many fossil species of *Purpurina*. It would seem that *Separatista*, Gray,

classed by Adams (Gen. I, p. 136) in the sub-family *Rapaninæ*, ought to form a genus in the *Trichotropidæ*, although Gray (Guide, 1857, p. 77) appears to unite it again with *Trichotropis*.

There are only very few fossil forms known which belong to this family. Gabb. (Pal. Calif. I, 1864, p. 138, Pl. XXI, Fig. 98) described lately a remarkable shell from the cretaceous rocks of California as *Lysis duplicosta* (n. gen. et sp.), which has the general form of *Fossar*, and partly that of *Narica* and *Stomatia*. Should it not belong to the *Naticidæ* or the *Velutinidæ*, which is, more likely, its only place would be in this family next to *Separatista*, Gray, although it is, properly speaking, very much allied to *N. carinata*, Sow., sp. (Trans. Geol. Soc. Lond., IV, Pl. XVIII, Fig. 8), which is very probably a *Fossar*.

The jurassic genus *Purpurina*, D'Orb., includes shells of the *Cancellaria*-or *Trichotropis*-form, anteriorly with a slightly produced aperture and an obsolete notch occasionally. The genus is generally classed with the *Buccinidæ*; but if we take the total form of the shell and that of the aperture into consideration, there is certainly no other family, the species of which possess quite similar characters, excepting that of the *Trichotropidæ*. Besides this relation *Purpurina* offers none to any other family excepting the *Littorinidæ*.

There are about 14 living species of *Trichotropis*, a few tertiary, and only one doubtful cretaceous species described under this genus by Conrad, *T. cancellaria*, (Journ. Acad. Nat. Sc. Phil. III, pp. 333 and 336, Pl. XXXV, Fig. 8) from Missisippi.

XL. TRICHOTROPIS, *Sowerby et Broderip*, 1826.

1. Trichotropis Koninckı, *Müller, sp.* Pl. XIII, Figs. 7—9.

1851. *Trochus Koninckı*, Müller, Petr. Aachner Kreide, II, p. 44, Pl. V, Fig. 11.
1864. *idem.* Pictet, Pal. suisse, 3me. Ser. II, pt. p. 533.

Trich. testa ovato-turbinata, columella excavata; anfractibus quinis, primis lævigatis, ceteris spiraliter dense striatis, infra medium acute carinatis, supra atque infra carinam plus minusve excavatis, transversim lamellose costulatis; costulis ad carinam plus minusve acute-elevatis seu coronatis; ultimo anfractu inflato, spira altiore, ad medium bicarinato, carina infera tenuiore; umbilici margine crasse carinato; apertura ovali, antice subemarginata, marginibus lævibus, dilatatis, postice continuis.

Spiral angle about 70°; sutural angle 12°.
Height of last whorl : total of shell (considered as 1·00) ... 0·54—0·63.

The height of the spire is somewhat variable in this species, although the number of whorls is usually only five. The last whorl, being, however, more or less inflated, covers a greater or smaller portion of the preceding whorls (each respectively), and the consequence is, that not only the spire becomes shorter, but that the carina of each whorl is in the first case nearer to the middle (see Fig. 7), in the other nearer to the lower suture (Fig. 8). On the last whorl there is always a second

keel below the upper principal one, and occasionally in large specimens even a third one is indicated; the former remains sometimes perceptible on the suture of the preceding whorls, when the spire is more turbinate.

The transverse ribs are simply the remainders of the margins of the outer lip, in no way thickened, and following closely each other like the slates of a roofing. On the keels they are more or less elevated, laminar,—probably they were more so in the living shell—and placed very similarly to those in the recent species, *Tr. bicarinata* and others. The spiral striæ are very numerous and of unequal strength; they are less marked, when the transverse ribs are stronger, but when these—in the young shell—are very slight, the spiral striation appears the more distinct (see Fig. 9). The aperture is oval, very oblique, with flattened and somewhat expanded margins, which are posteriorly thicker and united; both are entirely smooth internally and there is not a trace perceptible of any fold in the total length of the columella. The latter is hollowed out and on the last whorl strongly edged with a lamellar keel, terminating at the anterior notch of the aperture (sub-gen. *Iphina*, H. and A. Adams).

This species attains a considerable size, the largest specimen from Shutanure measuring 57mm. in height and 43mm. in width on the last volution. I have already noticed the similarity of this species to other tertiary *Trigonostoma*. There can be scarcely a doubt, that our fossil is identical with that described by Müller. As it is evident from our figures that the form of the shell varies with the height of the spire, there does not remain the slightest character, which could justify the separation of the Indian from the European species. Müller (loc. cit.) exerted himself in vain to prove the non-existence of the genus *Delphinula*, evidently merely to find a place for his very remarkable fossil in a generalisation of the character of *Trochus*; but his propositions certainly have no chance of being appreciated by most other conchologists, in fact they have remained unnoticed.

Localities.—N. of Kunnanore, E. of Anapaudy, and S. W. of Shutanure; at the former localities the species does not appear to be rare.

Formation.—Trichinopoly group.

2. Trichotropis nodulosa, *Stoliczka*, Pl. XIII, Fig. 10.

Trich. testa rhomboidali, spira ultimo anfractui in altitudine fere æquali; anfractibus circiter quinis, infra medium rotundate angulatis, ad angulum tuberculatis; superficie spiraliter striata, striis inæqualibus, ternis medianis crassissimis; collumella excavata, lævi, antice truncata.

Spiral angle 80°; sutural angle 8°.
Height of last whorl : total of shell (considered as 1·00) ... 0·55

The form of the shell, as a whole, is obliquely rhomboidal, consisting of about five volutions only, the last of which does not much exceed the height of the spire. The embryonal whorls are not preserved in our specimen; all the others are nearly

flat above, and at about the middle roundly angulated, each of the succeeding whorls reaching high up towards the angle, and covering the greater portion of the lower half of each preceding whorl. There are about twelve blunt, transversally elongated tubercles on the angle of each volution, being produced by a thickened elevation of the margin of the outer lip on the same, and disappearing quickly towards the sutures. The entire surface is covered with spiral striæ, unequal among themselves, generally alternately thinner and thicker; three are placed posteriorly, and the four which cross the tubercles, and which are all visible only on the last whorl, are the strongest of all.

The columella is hollow, and the inner lip without a trace of folds, as the interior, truncate edge of the canal, indicating a notch, cannot be compared with a fold or tooth. The margins of the aperture are not preserved, and remain to be traced; but judging from the total aspect of the shell, and its resemblance to the other species of *Trichotropis*, combined with the total want of any columellar plaits, there can be but little doubt that the species belongs to this genus.

Locality.—S. W. of Alundanapooram; the figured specimen is as yet unique.

Formation.—Trichinopoly group.

XVI. *Family—CANCELLARIIDÆ.*

(Vide Adams' Gen. I, p. 275; Gray's Guide, 1857, p. 23; Chenu's Manual I, 274).

The anatomy of the animals of the *Cancellariidæ* is in many respects as yet defectively known, but as regards the structure of the shell there is no question, that the place assigned by H. & A. Adams to the family, close to the *Cerithiidæ*, cannot be seriously objected to. In having generally a distinct siphonal fold on the mantle, and usually a more or less distinct canal on the shell, they undoubtedly ought to be located not far from the *Cerithiidæ* and towards the end of the Siphonostomata, forming thus gradually a passage to the Holostomata. There are some points of relation between the *Cancellariidæ* and the *Terebridæ*, which we shall notice subsequently.

The proboscis of the animal of *Cancellaria* is very short and rudimentary; the eyes are usually sessile on the outer side of prolonged tentacles, which are thickened, and close together near the basis; teeth and operculum are not exactly ascertained, although the former are stated by Troschel to resemble those of the *Conidæ*; these and other doubts increase a little the difficulty of classification, as I shall subsequently mention again in the *Terebridæ*. Looking to the shells of fossil as well as living species of the *Buccinidæ* and *Purpuridæ* on one, and the *Terebridæ* and *Cerithiidæ* on the other hand, they seem to be well placed between these two families. I would on this occasion recall the eocene species *Buccinum fusiforme*, Desh., *B. Andrei*, Bast. *B. Vicaryi*, d'Arch. (India), or the miocene *Buc. turbinellus*, Brocc. and other species, which have probably to be withdrawn from the *Buccinidæ* and placed in the family *Cancellariidæ*.

H. and A. Adams divide the family into two genera, *Cancellaria* and *Admete*, and quote a number of subgenera of the former. It is certain that the difficulty of distinguishing the quoted sub-genera of *Cancellaria* is very great, although every one, who had studied the fossil forms, must have seen the necessity of some kind of subdivision in the genus *Cancellaria*. Until the distinctions in the shells have been supported by some differences in the organisation of the animal, it will be advisable to retain H. and A. Adams' divisions as sub-geera.

Considering the fossil forms, the following observations may be found worthy of notice. It will always be very difficult to distinguish between *Cancellaria* proper and *Trigonostoma*, unless the last name is restricted to a very few *typical* species only. *Aphora* may better not be separated from *Merica*, while this latter and *Euclia*, *Narona*, *Massyla*, and *Admete* may probably for the most part be conveniently separated as genera.

There are about 70 species of *Cancellariidæ* known living, and about as many tertiary, of which some 50 are neogene and 20 eocene. It is interesting to see that those forms, quoted by Adams under *Cancellaria* and *Trigonostoma*, which are at least five times more numerous than the others in the present seas, are in the neogene period about equal in number to those of the other groups *(Euclia*, etc.*)*, while in the eocene period they form scarcely one-third of all the known *Cancellariidæ*, and in the cretaceous epoch only about one-fifth. This shows also a development of elongated, conical, non-or scarcely-umbilicated forms into ventricose and largely umbilicated species, a tendency in part similar to that known in the family *Volutidæ* and some others.

The species which are up to the present known as *Cancellaria* from cretaceous rocks are exceedingly few, and most of them rather doubtful, being known only from imperfect specimens.

Cancellaria.

1. *Canc. obtusa*, Binkh. (Mong. Gast. et. Ceph. 1861, p, 5, Pl. II, Fig. 2) belongs to the type of *Merica*, Adams, having a solid columella and the anterior termination of the aperture barely notched.
2. ? *Canc. reticulata*, Binkh. (ibid. p. 66, Pl. V$^{a\,2}$, Fig. 8) remains doubtful, not allowing even the determination of the family with certainty. This and the previous species are from the upper cretaceous deposits of Limbourg.
3. *Canc. Alabamensis*, Gabb (Jour. Acad. Nat. sc. Phil. Ser. II, 1860, IV, p. 301, Pl. 48, Fig. 14).
4. *Canc. Eufaulensis*, Gabb (ibid p. 390, Pl. 68, Fig. 8) ; imperfectly known; Gabb does not mention even any columellar folds, neither are they apparent in the figure.

Turbinopsis, Conrad, 1860. (Jour. Acad. Nat. sc. Phil. Ser. II, vol. IV, p. 289).

5. *Turbinopsis Hilgardii*, Conr. (ibid Pl. XLVI, Fig. 29).
6. *Turb.* (*Cancellaria*) *septemlirata*, Gabb (Proc. Acad. Nat. sc. Phil. 1860, p. 94, Pl. I, Fig. 10).

If there actually be only one columellar fold present the genus *Turbinopsis* ought to be separated from *Cancellaria*, as there are no such forms to be met with among living *Cancellariæ*. It has been proposed by Conrad for the former species and the author states, that there appear to be two or more species of this genus in the cretaceous

rocks of New Jersey, "occurring in the state of casts," etc. From the deficient state of preservation, in which the species of *Turbinopsis* have been found, it is really very difficult to ascertain, whether they belong to this family at all. The spiral striæ, or revolving lines as the American palæontologists usually call them, present in both of the species and the want, or at least non-appearance, of transverse ribs indicates rather a different character of ornamentation, from what is usual in the family *Cancellariidæ*. I would not be in the least surprised, if the two species were shown to belong to the family *Trochidæ* or *Littorinidæ, (Modulus)*. We describe in the following pages five species of *Cancellariidæ* from the South Indian cretaceous beds. In transferring two species, formerly described by Prof. Forbes as *Voluta breviplicata* and *V. Camdeo*, to this family, we do so in accordance with the general habitus of the shell, the character of ornamentation, the anterior position and unequal strength of the columellar folds, and the thickness of the posterior portion of the inner lip. All the Indian *Cancellariidæ* belong to the upper series of the cretaceous beds, and mostly to the Arrialoor group.

The *Canc. torquilla*, Zekeli, from the Alpine-Gosau deposits must be excluded, being a *Fasciolaria* or possibly a *Latirus* ; there are, however, two as yet undescribed species of *Cancellariidæ* known to occur in the same deposits *(vide* Sitz. Akad. Wien, 1865, LII, Revis, &c., p. 80) ; and these being included we may fix the number of presently known cretaceous species belonging to this family at thirteen, four being European (one doubtful), four North American (two doubtful), and five South Indian, thus at least approximately showing that the family appears to have been more numerous in the tropical regions during the cretaceous time, precisely as during the present epoch it is nearly exclusively confined to those seas. Only a few species are known from the Mediterranean sea.

XLI.—CANCELLARIA, *Lamarck*, 1799.

1. Cancellaria annulata, *Stoliczka*, Pl. XIII, Fig. 11.

Canc. testa ovali, spira brevi-subacuta ; ultimo anfractu ventricoso, spira altiore ; anfractibus spiraliter striatis, transversim costulatis ; striis elevatis, filiformibus, interstitiis latioribus separatis ; costulis circiter ternis in uno circuitu crassioribus, varicosis, ceteris tenuioribus atque inter se nonnunquam inæqualibus ; columella arcuata, triplicata.

Spiral angle 65° ; sutural angle about 10°.

Shell ovate, the last whorl ventricose and largest. There are only about five or six whorls present, and all of them are ornamented with spiral elevated striæ and transverse ribs, exactly similar to those in typical *Cancellariæ*. The spaces between the spiral striæ are broader than the thickness of the striæ themselves, which being crossed by the transverse ribs produce a reticulated surface of the shell. The ribs are, however, always stronger than the striæ, and generally about three of them in

each whorl are much thicker, forming elevated ridges; all frequently cross the whorls obliquely. The embryonal whorls, the outer lip, and the termination of the anterior canal are not perfectly preserved in our specimen, and have been restored in outline in their probable shape. The columella exhibits three oblique strong folds, placed close to each other; the posterior portion of the inner lip does not appear very thick, as the spiral striation of the whorl is pretty clearly perceptible. The columella appears to have had only a somewhat broad fissure at its anterior termination, being solid internally.

Binkhorst's *Cancellaria? reticulata* (Gast. et. Ceph. Limbourg, 1861, p. 66, Pl. V $^{a\,2}$, Fig. 8), exhibits a somewhat similar ornamentation, but there are no such stronger varices marked by the author, and the transverse ribs appear on the whole to be more numerous.

Locality.—Olapaudy; the figured specimen is the only one yet obtained, and is undoubtedly a great rarity as a cretaceous fossil.

Formation.—Arrialoor group.

Euclia, H. and A. Adams, 1853.

The principal character of *Euclia* is said to lie in the want of the umbilicus and the deep notch on the anterior termination of the aperture. Not being well acquainted with the living representatives we prefer for the present to retain the name only as a sub-genus of *Cancellaria*.

2. Cancellaria (Euclia) breviplicata, *Forbes, sp.* Pl. XIII, Fig. 12.

1846. *Voluta breviplicata*, Forbes, Trans. Geol. Soc. Lond. VII, p. 132, Pl. 12, Fig. 7.
1850. *Fusus breviplicatus*, D'Orbigny, Prod. II, p. 230, *idem*, Gabb, &c.

(Eucl.) testa ovata, apice acuminata, spira brevi, vix quartam partem totius altitudinis formante, ultimo anfractu ventricoso; anfractibus quinis, primis duobus lævigatis, ceteris transversim costulatis, infra suturam canaliculatis; costulis obliquis, in canali atque ad medium ultimi anfractus obsoletis; superficie spiraliter minute sulcosa, sulcis ad terminationes anfractuum solum distinctioribus, inter se inæquidistantibus atque inæqualibus; apertura ovata, postice acuta, subcanaliculata, antice truncata, effusa; labio postice valde calloso, margine columellari recto, biplicato, plica antica obliquiore.

Spiral angle 75°; sutural angle 11°.
Height of last whorl : total (considered as 1·00) ... 0·76.

The ventricose shell with a short, pointed spire, the short and very oblique ribs, being obsolete posteriorly below the suture and on the convexity of the last whorl are very characteristic distinctions of this fine species. Originally the entire shell, which is markedly solid, appears to be covered with impressed lines, remaining, however, more distinct and placed closer to each other only near the suture and on the anterior portion of the last whorl, where they are also of unequal width. Prof. Forbes speaks of 'two deep sulcations', but there is certainly only one

principal constriction of the whorls, as is also distinctly seen in his figures; but while there are usually two impressed lines in this sulcation, close to each other, there is often a third line seen above it, and it could only have been this to which Prof. Forbes refers as the second sulcation. On the upper volutions there is generally nothing seen of the impressed lines, the deeper sulcation only remaining visible.

The posterior portion of the inner lip is very much thickened, smooth, and separated from the equally thick outer lip by a narrow channel. The columellar portion of the lip exhibits two strong folds, the anterior of which is more oblique; they were not visible in Prof. Forbes' specimen, although he suspected their presence, and in that was undoubtedly more correct than D'Orbigny, who might rather have called the species a *Buccinum*, but not a *Fusus*, to which it has barely a resemblance, even in an imperfect state. The anterior emargination of the aperture is externally indicated by two sharp ridges, which mark its former limits, the lower one being more rounded.

Locality.—Comarapolliam, N. of Arrialoor; only a few specimens have as yet been found. Prof. Forbes' specimens are said to be from Pondicherry.

Formation.—Arrialoor group.

3. Cancellaria (Euclia) intercedens, *Stoliczka*. Pl. XIII, Fig. 13.

(Eucl.) testa ovate-elongata, spira brevi; anfractibus quinis, lente convexis, transversim costulatis, prope suturam constricte canaliculatis; costulis prope rectis, numerosis (15—30 in uno circuitu), lævibus, in ultimo anfractu infra medium evanescentibus; parte anteriori ultimi anfractus spiraliter impresse-lineato; apertura elongata, semielliptica, ad marginem interiorem prope recta; labro arcuato, tenui, labio postice calloso, antice biplicato; canali extus atque supra acute-marginato.

Spiral angle 70°; sutural 10°.
Height of last whorl : total (considered as 1·00) ... ... 0·71.

This species is intermediate between *C. breviplicata and Camdeo;* it has the habitus of ribs and of the whorls of the first, but the great number of ribs and the elongated form of the latter. There are only five volutions present, and the two uppermost are smooth; along the suture there is only one broad sulcation, but this is placed much nearer to the suture than in *Euc. breviplicata*, as will be better seen by a comparison of the respective figures. The transverse ribs amount on the last whorl to 30, and they become obsolete, after they have passed the middle of the whorl, where the spiral striation begins. The upper ridge, indicating and bounding the anterior notch exteriorly, is especially strong and sharp. The inner lip is thickened posteriorly, and has in front two oblique folds, being comparatively much thinner than in *Eu. breviplicata.*

Locality.—Comarapolliam, where a few specimens have been procured with the two other species of *Euclia.*

Formation.—Arrialoor group.

4. Cancellaria (Euclia) Camdeo, *Forbes, sp.* Pl. XIII, Fig. 14.

1846. *Voluta Camdeo*, Forbes, Trans. Geol. Soc. Lond. VII, p. 131, Pl. XII, Fig. 5.
idem D'Orbigny, Gabb, Pictet, etc.

(Eucl.) testa ovato-elongata, cylindracea; anfractibus senis, subplanis, gradatis, primis duobus lævigatis, cæteris transversim dense costulatis; costulis acutis lævigatis, postice ad suturam celeriter multo tenuioribus atque duabus lineis impressis intersectis; spira brevi, tertiam partem totius altitudinis formante; ultimo anfractu antice valde constricto, spiraliter impresse lineato; apertura oblonga, antice late effusa; labro ad marginem attenuato, antice intus lævigato; labio postice incrassato, calloso; columella recta, solida, triplicata, plica media crassissima; canali antice late emarginato, extus lineis tumescentibus acutis utrinque notato.

Spiral angle 65°; sutural angle 15°.
Height of last whorl : total height (considered as 1·00) ... ... 0·68.

The general form of the shell is cylindrical, being narrowed towards each end, more so on the spire, which measures only one-third of the total height. The uppermost two embryonal whorls are smooth, the following densely covered with smooth, acute, transverse ribs, being quite straight or parallel to the axis, indicating the height of the shell. There are 25 of those ribs on the last whorl, but their number is considerably less on the upper whorls, decreasing to only 12 on the fourth last, or the first on which the ribs appear. Along the suture the whorls are suddenly much contracted, and the ribs become thinner, being crossed here by two spiral furrows, closer to each other, than to the margin of the suture, so as to form on this small tubercles. Similar impressed lines or furrows are seen on the anterior portion of the last whorl, where it begins to become narrower.

The aperture is elongated, ovate, anteriorly broadly emarginated, which emargination is marked exteriorly by a broad furrow, exhibiting curved lines of growth and bounded on either margin with sharp swellings. The outer lip has a sharpened edge and interiorly, so far as is visible on a preserved anterior portion, it is smooth. The inner lip is posteriorly much thickened, callose, and smooth; anteriorly on the columellar portion it is straight, and bears three folds, the middle one being the strongest and the anterior more oblique than the two previous ones, of which the last is again more oblique than the middle one.

This singular fossil shell, to which the two other species of the genus here described are the only similar forms known, has been described by Prof. Forbes as a *Voluta*, but the general habit of the solid shell, the thickening of the inner lip, the folds and the canal scarcely leave a doubt that it belongs to the family of the *Cancellariidæ*, and in having a solid columella and a broad canal emarginated at the termination it can be only placed in the sub-genus *Euclia*. D'Orbigny seems to have already noticed some peculiarity in Forbes' species, because he added a query to the name, when quoting it in the Prodrome, II, p. 226, although the query appears rather to refer to the species than to the genus.

Locality.—Comarapolliam; only the single figured specimens has been found here. Prof. Forbes gives the locality Pondicherry.

Formation.—Arrialoor group.

XLII. NARONA, *H. and A. Adams,*

is distinguished by a much produced canal with attenuated termination, two principal columellar folds and crenulated margin of the outer lip; the forms united by H. & A. Adams under this name being very peculiar and different from the other sub-genera of *Cancellaria*, we do not hesitate to accept the same as a genus.

1. NARONA (CANCELLARIA) EXIMIA, *Stoliczka*, Pl. XIII, Figs. 15 and 16.

Nar. testa ovata, spira brevi, acuminata; anfractibus quinis, convexis, duobus primis minimis, lævigatis, ceteris lineis spiralibus impressis atque costis transversalibus, crassis ornatis; lineis æquidistantibus, numerosis, interstitiis latioribus separatis; costis inter se æqualibus, rectis, circiter duodenis in uno circuitu; apertura obliqua, elongate-ovata, utrinque ad terminationes subacuta, antice effusa; marginibus paulo incrassatis, labro intus ad marginem crenulato, postice parum insinuato; labio valde calloso, arcuato, antice biplicato, postice uniplicate-dentato; canali moderate prolongato, lateraliter quoddam curvato.

Spiral angle 70°—80°; sutural angle 7°—8°.
Height of last whorl : total of shell (considered as 1·00) ... 0·69—0·76.

This very fine shell consists usually of five strongly convex volutions, the last of which is always the most inflated, the height of the spire varying from 24 to 31 hundredths of the total height of the shell. The two uppermost whorls are very small, flattened (not inflated as usually in species of the *VOLUTIDÆ*), but smooth; the others are spirally sulcated and transversally ribbed. The sulci, or rather only impressed lines, are separated by interspaces, broader than their own width, while the same are between the transverse ribs very nearly equal to the thickness of the latter. The great regularity in the ornamentation, combined with the peculiar form of the shell, appear to be very constant characters of this species.

The aperture is placed obliquely to the axis of the shell, ovate, being pointed on each end and provided anteriorly with a notch in consequence of the prolonged canal; both margins are posteriorly united; the outer sharpened on its edge, thickened interiorly and denticulated, having near the posterior termination a slight sinuosity, although this barely affects the straightness of the transverse ribs; the inner lip is in its entire extent much thickened, posteriorly somewhat expanded with a short fold on the inner side, and anteriorly with two equal but not strong, very oblique, folds, which extend over the entire columella; the latter is solid; the canal produced, somewhat laterally bent, and very slightly recurved. This last peculiarity of the produced canal, the great thickness of the inner lip with two anterior equal folds, and the short posterior fold, as well as the solid structure of the shell bear decidedly a more striking resemblance to the *CANCELLARIIDÆ* than to the *VOLUTIDÆ*, to which otherwise this species could be referred.

The only fossil which I am aware of, and which, as regards its general form, bears some resemblance with our species is *Voluta Melo*, Schafhæutl (Süd-Bayerns Leth. geognostica 1863, p. 203, Pl. XLIX, Fig. 5). The specimen is said to have been

imperfect, and no columellar plaits are referred to either in the figure or in the singular description of the author. The locality and geological position are equally unknown; and most probably will remain so unless somebody else rediscovers the fossil and settles these points.

Localities.—Alundanapooram and Ninnyoor in Trichinopoly; at the former locality, which belongs to the Trichinopoly group, the species is not rare, but at the other locality only a single specimen has as yet been found. It is a small specimen and also somewhat slender, but it certainly does not belong to *Lyria formosa* (p. 97), which at the last locality in the same white limestone is pretty common. The ribs are not intersected near the suture by spiral sulcations, as they are in that species of *Lyria*.

Formation.—Trichinopoly and Arrialoor groups.

XVII. *Family—TEREBRIDÆ.*

(Vide H. and A. Adams' Genera I, p. 223; *Acusidæ* and *Pusionelladæ*, Gray, Guide, 1857, pp. 5 and 22; *Terebridæ* and *Pusionellidæ*, Chenu's Manual, I, pp. 218 and 221).

The animals of the *Terebridæ* have a small foot, the mantle enclosed, and the siphon more or less prolonged. The proboscis is occasionally strong, thick, and entirely retractile, sometimes, however, very short or even rudimentary. The teeth, so far as known from a few species, resemble those of *Conus:* they are subulate, elongate, and arranged in two series; in other species, however, no teeth have been discovered at all. The same is the case with the tentacles, which when present or at least externally traceable, are short, thick at the base, and close together on the side of the mouth or proboscis. The eyes are externally near the end of the tentacles, or within their length, or near the basis; sometimes they are said to be wanting.

The operculum is horny, ovate, and lamellar. The turreted shells are always distinguished by their solid structure, *more or less polished surface, and a large number of volutions. The mouth is either abrupt with a notch in front, or extended into a canal of moderate length; the outer lip is sharpened, not thickened exteriorly; the columella often more or less twisted, sometimes with one or two distinct folds, placed in a manner similar to those in several Cerithiidæ.*

Hörnes gave, in his Mollusca of the Vienna basin (Abhandlungen Geol. Reichs-Anst. Wien, Vol. III, p. 125), a few practical hints how to distinguish imperfect specimens of *Terebra* from *Turritella, Cerithium* and others, but it is not clear in what way he thinks a sub-division of *Terebra* practicable according to the differences in the spiral angle (vide ibid, p. 127).

H. and A. Adams propose to divide the family *Terebridæ* into two sub-families, *pusionellinæ* and *terebrinæ*. The former is subsequently (Genera, II, p. 656) referred to the *Buccinidæ*.

The *pusionellinæ* (*Pusionelladæ*, Gray; *Pusionellidæ*, Chenu) are represented by one genus only, *Pusionella*. They are turreted or ovately elongated porcellanous shells, with smooth polished surface, a tolerably produced anterior

canal, and a slightly twisted columella. The operculum is obovate, with a central, lateral, and internal nucleus. The animal does not seem to have been made known up to the present. It is possible that acquaintance with it may support Adam's subsequent proposition, which remains only a question of time. I would, however, draw attention to the similarity of the shells and operculum of *Pusionella* with those of the *CLAVATULINÆ*, a sub-family of the *PLEUROTOMIDÆ*. The general form of the shells does not exhibit any particular difference. Several of other *PLEUROTOMIDÆ*—*Mangelia* and *Cythara*,—have a totally similar structure of the shell, to what we find in *Pusionella*. The *Pusionella Nifat*, *P. scalarina*, and others have a distinct notch near the suture on the outer lip, and in all cases the posterior portion of the aperture is somewhat contracted or narrowed. The opercula are exactly the same in *Pusionella* and *Clavatula*, and it would not therefore be the least surprising if the animals would show us, that *Pusionella* belongs to the *CLAVATULINÆ*.

In the other sub-family—*TEREBRINÆ*—Messrs. Adams distinguish two genera, *Acus*, Humphrey, and *Terebra*, Adanson. If the animals were throughout so different as they are represented by the two typical forms in Adams' Genera, it would be worth while to support these genera by some distinctions in the shells. But the former distinction as regards the position of the eyes does not seem always to exist, and the latter, relating to the existence of a posterior sutural groove, tortuous columella, and anteriorly sinuated outer lip of *Terebra* as distinct from *Acus*, is almost impossible to retain. If these distinctions are to be really of any great importance, it appears as if we should then occasionally regard specimens unquestionably belonging to one and the same species as not only specifically, but even generically different. We should besides form a number of other small groups or sub-genera to receive those species which have a sutural band but no anterior sinus on the outer lip, and those which have a twisted columella and the same entire outer lip, both being distinct from *Acus* proper; otherwise we had better not have entered at all upon a division of the genus *Terebra*. Gray rejects (Guide, 1857, p. 6) Messrs. Adams' distinctions as to *Acus* and *Terebra*, uniting both under the former name. He adds, however, three other genera, *Subula*, *Leiodomus*, and *Dorsanum*, the last of which seems scarcely different from *Bullia*. The animal of *Leiodomus* is sufficiently different from *Terebra* and from *Bullia*, but it is very difficult to distinguish the shells from the latter. Speaking of *Subula*, Dr. Gray refers to some figures (of Quoy and Gaimard in Mrs. Gray's collection) which contradict his own characteristics. From all these remarks it will be sufficiently clear that we must wait for some time until the examination of the animals of *Terebra* has so far advanced as to support any proposed distinctions in the shells.

It remains finally to say a few words as regards the place which we have assigned here to the *TEREBRIDÆ*. We confess that it was almost accidental that the family has been treated here, because we could not find any other better or more appropriate place for it before. The natural relations to the *CANCELLARIIDÆ* on the one and to the *PYRAMIDELLIDÆ* on the other side would scarcely have called

for a separate explanation on our part had we not seen the subject of classification dealt with so very severely elsewhere. (Vide Deshayes' Anim. s. vert. bass. de Paris, 2nd edit., vol. II).

The *Cancellariidæ* are classed by H. and A. Adams in the so-called Rostrifera, by Gray in the Proboscidifera, but in both cases far apart from the *Terebridæ*, which are acknowledged to belong to the Toxifera, in the vicinity of the *Conidæ* and *Pleurotomidæ*. When we compare the animals of the *Cancellariidæ* with many of the *Terebridæ*, we find that both agree in the small foot; short tentacles, thickened at the base; sessile eyes on the outer base of the tentacles; usually in the presence of a short proboscis, and in the occasional want of a lingual membrane and teeth. I am not aware in how many species of *Cancellaria* the teeth have been examined, but Troschel says that the teeth of *Cancellaria* resemble those of *Conus*. Even if this is really throughout the case, all the similarities between the two families, the *Cancellariidæ* and the *Terebridæ*, cannot be sacrificed to the one single difference that *Terebra* has usually a prolonged sipho. Many of the fusiform shells of *Cancellaria* are not by any means so very different, that they could not be looked upon as transitional forms to *Terebra*, and they have also a short sipho. The only thing which could be done in an extreme case and which may actually have good reason, is to place both the families after the *Conidæ*, in which case the *Cancellariidæ* would form a transition to the *Volutidæ*.

Originally the *Terebridæ* were placed by H. and A. Adams immediately before the *Pyramidellidæ*. There does not seem in fact to exist such a great difference between the animals of *Terebra* and *Pyramidella*, as generally supposed. The form of the foot, short head, proboscis and tentacles, generally unarmed tongue, or rudimentary teeth, are certainly, as already stated, very like in both. The differences consist in the foldings of the tentacles, the internal position of the eyes in *Pyramidella* and the prolonged sipho in *Terebra*. As regards the form and structure of the shell there is certainly no other group of Mollusca more related to many fossil *Pyramidellidæ* than most of the recent *Terebridæ*. The fossil species of *Nerinea* and others, which certainly have their recent representatives in *Pyramidella* and *Obeliscus*, are thus most closely allied to the *Terebridæ*, so that to make a distinction between them is sometimes almost impossible, even among better preserved specimens. I do not understand why Mr. Deshayes should so very much regret that H. and A. Adams did not state particularly their reasons for having placed the *Terebridæ* before the *Pyramidellidæ*. (Vide An. sans vert. Foss. bas. de Paris, Vol. II, pp. 529 and 530, and Vol. III, pp. 513 and 514.) I am rather more surprised that those conchologists who refer *Terebra* to the *Buccinidæ*, have not thought it necessary to explain their reasons for doing so. They have, it is true, the authority of Lamarck, Quoy and Gaimard, but with those authorities they seem to have remained contented. Lamarck predicted the relation of *Terebra* and *Buccinum (Nassa ?)* from the supposed similarities of the shells, in which he was evidently supported by referring several species of *Northia* and *Bullia* to *Terebra* and *vice versâ*. Certainly

there are several species of *Terebra*, which greatly resemble some species of the *Buccinidæ*, but the largest number is decidedly more allied to the *Pyramidellidæ* or even to the *mitrinæ* of the *Volutidæ*.

Quoy and Gaimard, when they made known the animal of *Terebra*, stated—perhaps guided by Lamarck's suggestion—that this genus has to be classed close to *Buccinum*. (Vide Voy. d. Astrolabe, Zoologie, Vol. II, p. 461, Atlas, Pl. XXXVI). Further on the authors note the great relations of the animal of *Terebra* and *Mitra*, and state even that, in case any operculated *Mitræ* are found, the passage between both would be so great, as to make a distinction almost impossible. The animals of the *Terebridæ* are no doubt more like those of the *mitrinæ* than those of the *Buccinidæ*. It appears to me, when comparing the animals of *Terebra* with those of *Nassa*, *Phos*, *Bullia*, and others, that they have nothing more in common with each other than the elongated siphon; the examination of the teeth showed equally a great difference between both families. On what ground, therefore, the *Terebridæ* ought to be classed with the *Buccinidæ* I am at a loss to perceive. We do not wish in the least to enforce the idea, that the *Terebridæ* are correctly classed next to the *Pyramidellidæ*, but we confess that upon looking over the extensive number of fossil species of the latter family, we are at the present unable to assign for them a better place.

The *Terebræ* live generally near the low water-mark, and are to be found in greatest variety in the eastern tropical and sub-tropical seas. Reeve described, 1860, in his last Monograph of *Terebra* 155 species, after rejecting some of the new species of Hinds and Deshayes, published in previous Monographs of the same genus. Since 1860 a few new species have been described in the Journal de Conchyliologie; Proc. Zool. Soc.; and elsewhere, so as to bring up the number of living *Terebra* to about 170 species.

There are from the tertiary deposits about 30 specis of *Terebra (Acus)* quoted, some of which occur also living. A large number comparatively is known from America. Already in the eocene beds *Terebra* becomes very scarce, and, as regards the cretaceous, Prof. Pictet properly remarks that no species of Terebra are there known with certainty. (Vide Mat. Pal. Suisse, ser. III, p. 677.)

The *Terebra coronata*, Sow., from the Alpine Gosau-deposits—*Cerithium pseudocoronatum*, D'Orb., is probably a *Tympanotonos*, in which case the change in the specific name would not be required.

The *Terebra minuta*, Galeotti, from Mexico is called by D'Orbigny *Cerith. sub-minutum*.

Terebra obconica, Sharpe, from Portugal has the form of *Terebra*, but the specimens upon which it was founded appear fragmentary on the aperture and with the surface worn off, although the description does not refer to either. The columella is not twisted.

The name *Terebra cingulata*, in Giebel's Petref Deutsch., p. 481, refers to *Fusus cingulatus*, Sow., from the Gosau (Zekeli's Gastropoden der Gosaugebilde, p. 91, Pl. XVI, Fig. 7, in Abhandlung. der Geol. Reichs-Anst. 1852, Vol. I). Dr. Zekeli considered the species first as a *Terebra*, but retained afterwards Sowerby's determination. I have in my revision (Sitzb. Akad. Wien, 1865, vol. LII, p. 83) remarked, that the species may not unlikely be proved to be a *Terebra*, although it has not a tortuous columella, but a distinct sutural band. No perfect specimens have been as

yet observed. The remains of stronger varices at shorter or longer distances would, on the other hand, rather speak against a *Terebra*, and would be more in favor of a species of the CERITHIIDÆ.

We have nothing to add from the South Indian cretaceous deposits.

A few jurassic species have been described as *Terebra*, namely, *T. melanoides*, Phillips (Yorkshire, 1829, p. 102, Pl. IV, Fig. 13), *T. granulata*, Phill. (ibid. Pl. VII, Fig. 16), and the *T. Portlandica*, Sow. (Trans. Geol. Soc. Lond. IV, p. 349, Pl. XXIII, Fig. 6). None of these is certain; the first was referred by D'Orbigny to *Chemnitzia*; the second by Lycett (Supp. Monog. of Moll. etc. 1863, p. 10, Pl. XXXI, Fig. 12) on account of a single columellar fold (this would not prevent its being a *Terebra*) to *Nerinea*, and the third by D'Orbigny to *Cerithium*.

XVIII. *Family—PYRAMIDELLIDÆ.*

Under this name we retain most of the typical forms of *Pyramidella*, *Obeliscus* and others, as stated by H. and A. Adams, and add to these the numerous fossil species known commonly under the name of *Nerinea*.

The characteristics of the family may be put thus:—

Turreted or broadly conical shells, with usually sinistral apex and the aperture anteriorly effuse, obsoletely notched, or produced into a shorter or longer canal; inner lip generally, outer lip occasionally, plaited.

The opercula of the living genera are narrow, elongated, horny, sub-spiral, with a notch on the internal side. The animals have a small foot without or with a small operculiferous lobe, short and anteriorly folded tentacles, which are thickened at the base, and have the eyes on the internal edges near the basis, sessile or on thick bulgings. The teeth are said to be wanting or rudimentary. The proboscis is figured by Quoy and Gaimard (Voy. Astrolabe, Atlas Pl. LXVII) trumpet shape, of a form very similar to that of *Terebra* (ibid. Pl. XXXVI, Fig. 17). The mantle is generally provided with a distinct siphonal fold. Some of the living animals, of *Obeliscus* at least, must have a short produced siphon and turned upwards, otherwise it would be impossible that such a distinct ridge with insinuated striæ of growth could be formed at the anterior termination of the last whorl, as can generally very distinctly be observed in *Obeliscus*, and in *Pyramidella* very often also. On this account, supported by the well developed anterior canal in the fossil *Nerineæ* (and thus allowing a conclusion as to a relatively greater development of the sipho), we think it advisable to retain this family in the SIPHONOSTOMATA, as long as this latter tribe of CTENOBRANCHIA cannot easily be replaced by some better arrangement.

It is true that the genera *Odostomia*, *Turbonilla*, and others can in no way be sufficiently characterized as SIPHONOSTOMATA, but according to what is known about the animals of all the different genera, they appear to be so thoroughly identical, that it is impossible to keep them separate. There is, as I have already mentioned, some kind of disharmony and evident insufficiency in every systematical attempt.

Pictet offered some able remarks on the *Pyramidellidæ* in his Mat. p. l. Pal. Suisse, 3me. ser., p. 214, and still more Deshayes in his recent edition of the Paris fossils, Vol. II, p. 527. Both are disposed to retain the family as it had been delineated by Gray in his Guide of 1857, p. 57. Forbes and Hanley say very properly of this family "rather as appertaining to past ages than the present epoch." (Hist. Brit. Moll. Vol. III, p. 217.) Deshayes (loc. cit. Vol. II, p. 529) remarks also that the extensive genus *Nerinea* ought to form a distinct family from the *Pyramidellidæ*, with which we cannot agree for a moment. The shells of the largest number of *Nerineæ* are not only totally alike to those of *Pyramidella* and *Obeliscus*, but it will be and is indeed, almost impossible to separate exteriorly some *Nerineæ* from *Obeliscus*.

The last Monograph of *Pyramidella* by L. Reeve (Conch. Icon., pt. 250 and 251, 1865) contains the descriptions of 45 species, but some of them belong to *Syrnola*, *Monoptygma*, and others. Perhaps there are scarcely more than 30 which may be retained as *Obeliscus* and *Pyramidella*.

The tertiary species scarcely amount to 20, of which more than half are eocene. Deshayes described lately eight; Morris indicates three from the English eocene, and a few are noted from America. Scarcely a single species of the group of shells, known as *Nerinea*, has been reported from tertiary beds.

Before we enter upon the cretaceous fauna, it will be probably useful to give first a short review of the genera which belong to the family *Pyramidellidæ*, and we begin, thus, first, with living forms.*

1. *Pyramidella*, Lamarck, 1796.—Shell turreted, conical or ovate; whorls transversally ribbed; columella usually solid, with three oblique plaits, the posterior of which is the largest; outer lip generally thickened externally, smooth internally; aperture anteriorly effuse and obsoletely notched.

There have been up to the present only eight or nine species described—all from the eastern seas,—but several new species have been discovered since by A. Adams.

2. *Obeliscus*, Humphrey, 1797.—Shell turreted, elongated; whorls smooth and polished; columella usually hollowed out, with two or more oblique plaits; outer lip internally often striated, and with remaining internal varices at some distances; the margin sharpened or somewhat expanded; aperture in front distinctly produced into a short canal and often notched at its termination. The living species of *Obeliscus*, which amount to 20 or 21 only, are also chiefly inhabitants of the eastern seas, although a few are known from the West Indies.

* I have published some provisional notes on the genus *Nerinea* in the Sitzungsb. d. Akademie, Wien, Vol. LII, 1865 (Revision d. Gastropoden, etc., p. 24), and I have since been anxiously looking for a collection of fossil Gastropoda, which was ordered from Europe for our Museum. Unfortunately the lamented death of Mr. L. Sæmann in Paris caused a delay in the despatch of this collection, and we shall have to wait now a little longer, until some of the desirable comparisons and examination of fossils can be carried out. On this account I would not like to go farther into the examination of the *Nerineæ*, than to point out a few generic types by a reference to already well known fossils. It would not be advisable in every case to propose names for them; a delicate question of this kind ought not to be settled upon mere figures of mostly incomplete specimens.

These two genera are usually treated by conchologists under the more general name of *Pyramidella*, and under this name there have been a few cretaceous species noticed. Strictly speaking, there is, however, from cretaceous beds not a single species known which corresponds exactly with the living and tertiary species of *Pyramidella** or *Obeliscus*, unless it be the *Pyramidella æquiplicata*, which name has been proposed by Deshayes for a species figured by Walch in the "Naturforscher," Halle, 1774, Vol. I, p. 204, Pl. III, Fig. 3, a publication to which I am for the present unable to refer.

3. *Monoptygma*, Lea, 1833 (H. and A. Adams' Gen. I, p. 234).

3, *a*. *Menestho*, Möller, 1842.—This sub-genus quoted by H. and A. Adams (*ibid.*) is subsequently acknowledged by A. Adams as a good genus, although it hardly appears to be sufficiently characterized (Ann. Mag. Nat. Hist. 1861, ser. 3, Vol. VII, p. 296).

3, *b*. *Odostomia*, Flem., 1848 (H. and A. Adams' Gen. I, p. 232) includes the species with somewhat shorter spire and inflated last volution; the surface is smooth and polished in typical forms.

3, *c*. *Syrnola*, Adams, 1860 (Proceed. Zool. Soc. Lond., 1862, p. 233); *shell subulate, turreted, polished, whorls smooth, plain; aperture oblong; inner lip with an oblique fold in the middle; outer lip sharp.* The anteriorly ovate aperture and the presence of only one fold on the inner lip distinguished this genus from *Obeliscus*, to which it is otherwise a closely allied form.

3, *d*. *Styloptygma*, Adams, 1862 (Proc. Zool. Soc. Lond., 1862, p. 235) contains a number of species of *Syrnola*, which are inflated about the middle of the spire, somewhat of the shape of a *Pupa*, *Clausilia* or *Colina*; the whorls are smooth or slightly ribbed.

3, *e*. *Chrysalida*, Carpenter, 1858 (H. and A. Adams' Gen. II, p. 622) are also pupiform shells, with usually a cancellated surface and one columellar plait; aperture contracted, peristome continuous.

3, *f*. *Amathis*, A. Adams 1861 (Ann. mag. nat. Hist. VIII, p. 303), is another form with one posterior fold.

4. *Elusa*, Adams, 1861 (Ann. Mag. Nat. Hist., 1861, 3rd, ser. Vol. VII, p. 297, and Proc. Zool. Soc. Lond., 1862, p. 237). Mr. A. Adams has proposed this name for the elongated, turreted species of *Turbonilla* with transversally plicated whorls and one columellar fold; it appears advisable to retain this genus.

* Schafhæutl (Lethea Geog. Süd-Bayerns, 1863, p. 387, Pl. LXXIV, Fig. 3) notices a *Pyramidella tornatilis*, D'Orb., although I am unable to find the reference. I would not be surprised if the author wished to designate *Actæon tornatilis*, Montf. and confounded both names, as in the case of *Actæon Vibrayeana*, D'Orb., which he evidently quotes on the next page as "*Actæonella Vibrayana.*, D'Orb." The species above referred to is quoted from the same beds as *Pyram. canaliculata*, D'Orb., and would be therefore a cretaceous fossil, but I am afraid the one determination is quite as little to be depended on as the other.

5. *Turbonilla*,* Leach, 1826 (? 1819) (H. and A. Adams' Gen. I, 230).—It is known that, when Risso first introduced the name *Turbonilla* of Leach, he described under it species with and without a columellar fold. Several conchologists, and among them Deshayes in his last edition of the Paris fossils, retain the genus in the same sense as Risso, others have proposed distinctions in various ways. The name *Turbonilla* was consequently applied to species with a fold, while others without the same have been referred to *Chemnitzia* of D'Orbigny. Again, the names *Turbonilla* and *Chemnitzia* were considered as identical by Gray, Deshayes and others and this once admit ted, another time the other name is allowed to have priority. In many works on recent conchology the name *Turbonilla* was reserved for the non-plicated species only, and the confusion would be probably cleared up in the easiest way, if the genus was retained in the sense as introduced by H. and A. Adams in their Genera. *Chemnitzia* as subsequently commented on by D'Orbigny (in his Pal. franç. terr. jur.) must be kept thoroughly distinct. The name was founded first upon a plicated *Turbonilla*, for which A. Adams proposes now the name *Elusa*; there is therefore, strictly speaking, no reason whatever to regard *Turbonilla* and *Chemnitzia* as identical. We shall speak subsequently of the latter genus in the family *Eulimidæ*.

6. *Eulimella*, Forbes, 1846 (H. and A. Adams, Gen. I, p. 233).—According to the account given of the animal, this genus, like *Turbonilla* itself, cannot be excluded from the family *Pyramidellidæ*. The whorls have in fact the typical squarish shape, with flattened, not produced basis, as is invariably the case in *Chemnitzia*.

6*a*. *(Aciculina)*,† Deshayes, 1864 (Paris foss., 2nd edit., Vol. II, p. 530). By this name have been called a few eocene species which differ from *Eulimella* by a greater convexity and perhaps a larger number of whorls. The *(Aciculina) emarginata*, Desh. (loc. cit. p. 533, Pl. XXV, Figs. 25—27, not 26—28) is a *Chittia*, and the other species may be regarded as transitional forms to those smooth species of the *Cerithiopsidæ*, which H. and A. Adams called *Alaba*.

Of all these generic forms noted under numbers 3—6 not a single species has yet been fully ascertained to occur in cretaceous strata, although a large number of species are known from the eocene and neogene beds. It is, however, very probable that when more attention has been paid to those little shells, they will not be found wanting in the mezozoic formations. The only cretaceous species of *Odostomia* will be described subsequently from our South Indian cretaceous deposits. The cretaceous *Turbonillæ*, described by Conrad (Journ. Acad. Nat. Sc. Phil. iv) are referred by Gabb in his 'Synopsis of cretaceous fossils' to *Chemnitzia*, which appears in general correct, but a few species like *Turb. Spillmani* are undoubtedly more allied to *Turbonilla* than to *Chemnitzia*.

* *Dunkeria*, Carpenter, 1858 (H. and A. Adams' Gen. II, p. 622) has been proposed as a sub-genus for certain forms of *Turbonilla* with *tumid and cancellated whorls*, but it is considered by A. Adams as more allied to *Aclis* and we shall notice it, therefore, in the *Eulimidæ*. The species are mostly from Mazatlan.

† This name has been already, in 1853, used by H. and A. Adams (vide Gen. I, p. 121) as a sub-genus of *Nassa*.

7. Nov. gen.—*Pyramidella involuta*, Müller (Petref. Aach. Kreideform. II, 1851, p. 9, Pl. III, Fig. 10) is rightly quoted by Pictet as a doubtful species. The author says that it is based upon a complete specimen, although the figure does not show this. I am not acquainted with any *Pyramidella* or *Obeliscus* which have the spiral striation or rather ribbing so distinct as this species, and if it really belongs to this family—for Dr. Müller does not mention any columellar plaits—it could in conjunction with two species, described by D'Orbigny as *Nerinea Marrotiana*, and *perigordina* (Pal. franç. crét. II, Pl. 163 bis.), probably be conveniently separated into a distinct genus. A closely related form among living shells would be perhaps *Fastigiella*, Reeve, which has, however, a distinct recurved canal and a somewhat expanded outer lip, for which reason it has been transferred to the *Cerithiidæ*. The forms called by A. Adams *Seila* are also spirally striated, but have no columellar plaits, and have been therefore placed in the *Cerithiopsidæ*.

8. *Itieria*.—Matheron proposed (Bull. Soc. Geol. XIII, p. 493) this genus for a species subsequently described and figured by D'Orbigny as *Nerinea Cabanetiana* (Pal. franç. terr. jur. II, p. 99, Pl. 255, Fig. 4, and Pl. 256), and I believe the genus ought to be restricted to forms like this species only. The characteristics can be put thus :—

Shell ovately elongated, with longer or shorter subconical spire ; last volution ovate or cylindrical, anteriorly convex and posteriorly partly enveloping the previous whorls ; aperture prolonged, narrowly compressed, or ovoid with 1-3 *folds on the inner lip, and usually one fold about the middle portion of the outer lip, anteriorly with a narrow and slightly prolonged canal, producing a sharp edge on the termination of the hollow columella, and being continuous and distinctly traceable on the basis of the last volution.*

The surface of these shells is usually smooth or transversally ribbed. The columella, which appears to be invariably hollowed out, is usually provided with only two folds and the outer lip with one, although the latter seems to be often present only during a certain stage of life. We may quote a few of the principal species, to which we would restrict Matheron's name; *Itieria (Nerinea) Cabanetiana, Moreana, fusiformis, Clymene, pupoides* and *Mosæ*, described by D'Orbigny in Pal. franç. terr. jur. II; *Ner. tornatella*, Buvignier; perhaps the *Ner. Staszycii*, Zeuschner, sp. (Sitzungsb. Akad. Wien, 1855, Vol. XVI, p. 350); farther the cretaceous species, *Nerinea cyathus, Meriani, rostrata*, Pictet et Campiche in Mater. p. l., Pal. Suisse, ser. III; *Ner. Bauga*, D'Orb; *Itieria abbreviata*, Phil. sp. (Sitz. Akad. Wien, LII, 1865; Revision of the Gosau Gastropoda, p. 41) and some others.

The principal differences of this genus from *Nerinea* lie in the ovate form of the last volution and in the form of the anterior termination of the aperture. These two characters agree perfectly with *Obeliscus*, and if there were numerous short small folds on the inner side of the outer lip, as they are usually exhibited in the living *Obeliscus*, there would be absolutely no possibility of distinguishing these fossil species from the last named genus.

I am not aware whether the forms, which I have quoted as *Itieria*, possess a sutural band like *Nerinea* proper; none of the figures show it distinctly. I am quite at a loss for the present where to place the two jurassic species, *Nerinea Mandelslohi*, Bronn, and *N. gradata*, D'Orb. If they do not, however, possess a sutural band, I do not think that they can be rightly excluded from the genus *Itieria*. Matheron instituted his genus, as I have already mentioned, only for the one species, *Ner. Cabanetiana*; but if we compare with this, for instance, the *Ner. pupoides*, it becomes evident that there is apparently no other important distinction between those two, than that the latter has one additional plait on the inner lip. We know, however, from species like *Itieria abbreviata* and others that this second fold is like the one on the outer lip, sometimes present, and in other cases wanting. In some other species there seem to be three plaits present, as in typical *Obeliscus*; we cannot therefore give the existence and number of these plaits an absolute generic value, although they always may help us in characterizing species.

A second character, to which M. Matheron has drawn attention, is the abbreviation of the spire. This appears to me of far less importance. I have had a good deal of experience in collecting large suites of *Nerineæ* and *Actæonellæ*, and my impression is, that both these genera were principally inhabitants of shallow beaches between high and low water-mark, and that they often lived on stony ground or on coral reefs as the recent *Obeliscus* usually do. It is not often the case that a shell, which is to a great extent almost involute in the first stage of growth, becomes afterwards merely turreted, and this apparently turreted form is only produced by an erosion of the posterior margins of each whorl. Much more frequently it happens that the spire of the large shell is more or less eroded on the stony ground on which it lived, or before it had been finally imbedded in the rock. In some specimens this occurs probably during the young state of age, in others later, and again in some, which live in favorable and sheltered places, perhaps never, or to a much smaller degree. I do not know whether I am quite correct in these statements, but they have been derived from actual and practical observations. I may refer here to a few figures of *Itieria abbreviata* in the 'Jahrbuch Geol. Reichs-Anstalt', Wien, Vol. XIII, page 48, which species and the few described by Pictet are the only cretaceous forms apparently belonging to *Itieria* proper.

All these observations induce us to extend Matheron's name to forms with a conical or even turreted spire. It is due to Pictet and Campiche, that they have again introduced the name *Itieria* into the literature of fossil Mollusca, for D'Orbigny seems to ignore the genus altogether when speaking of his *Ner. Cabanetiana*, although it was certainly not unknown to him when he claimed the priority of his *Actæon*. The authors of the Materiaux pour la Paléontologie Suisse, 3me. ser., add to Matheron's species two other somewhat different forms, which we would be rather inclined to separate under the following designation of

9.—*Itruvia*, Stoliczka, 1867.

Testa ovata, seu conica, spira plus minusve elevata aut abbreviata; ultimo anfractu maximo, inflato; apertura lateraliter multo angustata, antice canaliculata, postice acuminata; columella solida, tortuosa, uni- seu bi-plicata; (labro intus edentulo; superficie testæ lævigata).

We deduce these somewhat incomplete characteristics from the five species which are at present known, namely,—

1. *Itruvia (Pyramidella) canaliculata*, D'Orb., Pal. Franç. terr. crét. II, p. 104, Pl. 164, Figs. 3—6.
2. „ *(Pyramidella) carinata*, Reuss, Böhm. Kreidef, II, 1847, p. 110, Pl. XLIV, Figs. 6 and 7). *(Pyr.) subcarinata*, D'Orb., Prod. vol. II, p. 191.
3. „ *(Itieria) truncata*, Pict. et Camp. Mat. p. 1, Pal. Suiss. 3me. ser., p. 218, Pl. LXIII, Figs. 1—4.
4. „ *(Itieria) umbonata*, Pict. et Camp. ibid. p. 220, Pl. LXIII, Fig. 5.
5. „ *globoides*, Stol., a new species, described in the following pages, and figured Pl. XIV, Fig. 1.

We unite also under the name *Itruvia* forms, which differ considerably in the height of the spire; this being in the two first named species produced, and almost turreted, in *It. globoides* short, and in the two described by Pictet scarcely elevated at all. These are therefore exactly similar changes, to those we have already noticed in *Itieria*. The reason, however, that we have separated the above named forms from *Itieria* lies principally in the formation of the columella and that of the anterior canal. The columella is always solid, twisted, and causes the presence of a short produced and slightly recurved anterior canal on the aperture, while in *Itieria* the aperture is itself more produced, without forming a regular canal. Certainly this must be connected with some distinctions in the animals. The differences are, I am well aware, not absolutely sharp, just as they are not in scarcely any other genera, and transitions could or may be in time traced; but the distinctions are in any case quite as truly serviceable as those proposed between *Pyramidella* and *Obeliscus*, perhaps even still greater.

In *Itruvia truncata*, Pict. and Camp., two columellar plaits are known; all the other four species have only one plait, and in all cases they are placed anteriorly and are thus strictly columellar. No folds have been as yet observed on the outer lip in any of the five species, which all present a smooth surface on the exterior of the shell. The ventricose form of the last volution and the presence of a distinct canal are equally important distinctions between *Itruvia* and *Syrnola*.

10. *Nerinea*, Defrance, 1825.

Testa turrita, perlonga, anfractibus numerosissimis, plus minusve applanatis composita; ultimo ad peripheriam basalem angulato, antice abrupte terminanti; apertura angulari, antice sub-canaliculata; columella plerumque solida; (— ? interdum excavata) labio sæpe tri-, labro intus bi-plicato, ejusque peristomate S-formi sinuato; in anfractibus omninis fascia distincta, lineis minutissimis insinuatis ornata, postice infra suturam posita est.

With these characteristics we would restrict the name *Nerinea* to the much elongated and turreted shells, which have the last volution built in a perfectly symmetrical way to all the other whorls, so as not to exceed them considerably in size and form. It is angulated at the basal periphery, and terminates abruptly in a short, anterior canal. Each whorl has below the suture a narrow band, formed of solid shell-mass, on which, however, in cases of good preservation, fine insinuated lines of growth are traceable. This band, of which we shall always speak as the "sutural band," recalls, according to D'Orbigny, the somewhat similar form in *Pleurotomaria.* I have never had an opportunity of observing any *Nerinea* with perfectly preserved aperture, and cannot therefore say whether there is a posterior emargination present or not; if it is, as no doubt would appear very probable, it can be only small, for I did not observe it in nearly perfect specimens of *Ner. Buchi* and *nobilis.* I have also not been able to get very distinct sections of the shell, but it seems to me that the shell-mass which constitutes this sutural band is rather more in connection with the thickening of the inner than with that of the outer lip. Below the suture the striæ of growth are always curved in an S-form, depending upon a similar curve of the margin of the outer lip.

There are usually three or four folds present on the inner and two on the outer lip. Of the former, two are, strictly speaking, placed on the columella, the anterior stronger than the posterior, and two in a similar position on the inner lip, which forms the top of the angular aperture. I have consequently called them in my former notes on *Nerinea* the top-folds (*vide* Sitzungsb. Akad. Wien, 1865, LII, Revision etc. p. 25); they might perhaps be better called posterior folds. But it is scarcely necessary to make always these subordinate verbal distinctions, unless a special importance is attached to them. If figures of specimens be not given, lengthened descriptions and explanations cannot be avoided. Of the two columellar plaits the posterior is, although nearly always smaller, generally present, but it disappears often sooner towards the aperture, than the other plaits. Still in process of growth all the plaits in the interior of the whorls become usually thicker and often fill up the space perfectly. In consequence of this the uppermost whorls become often easily corroded, having been placed out of connection with the organism of the animal.

The columella is usually solid or only fissured on the last whorl; seldom it is hollowed out in its entire length as in the jurassic *Nerinea grandis* and *dilatata*, D'Orb., but it is always distinctly twisted.

10 *a.* By far the larger number of the *Nerineæ* with a hollow columella are cretaceous; they are mostly smooth shells, with angular whorls contracted in the middle, and three plaits in the aperture, one columellar, one posterior plait, and one on the outer lip. It is possible that in these forms another small group of *Nerineæ* may be distinguished, but I am quite unable to come to any certain conclusion, as I have nothing but mere figures to compare, and these refer often to casts of shells only. The doubtful *Pyramidella sagittata*, Sharpe, (Quar. Jour. Geol. Soc. VI, 1850, p. 193, Pl. XX, Fig. 8) belongs evidently to this group.

10 *b*. One of the oldest forms of *Nerineæ* is the *N. prisca*, Hörnes (Denksch. Akad. Wien 1856, XII, part II, p. 27, Pl. I, Fig. 4) from the Alpine Trias of Lower-Styria. It must, however, be remarked that the columella and the disposition of the folds differs remarkably from the typical *Nerineæ*, as above characterized It has also no plait on the outer lip, and if the columella was straight, there may have been on the aperture itself only some emargination (if any) like a notch, notch similar to what is to be found in *Bullia* and other *Buccinidæ*. In such a case I rather believe it more correct that the species ought to be generically separated.

I do not know whether any of the six species of *Nerineæ*, described by Stoppani from the upper Trias (vide Pal. Lomb. ser. I, Pétrifications d'Esino, 1858-60, p. 35-37) belong at all to this group of shells. None of them has columellar folds like other *Nerineæ*, and some of the species look much more like *Chemnitzia*, *Holopella*, *etc.* There are scarcely any species of *Nerineæ* known from the Lias, but typical forms occur already in the lowest beds of the Dogger; they are most abundant in the Malm or Upper Jura, and decrease gradually in the cretaceous period. Pictet and Campiche (Mat. p. l. Pal. Suisse, ser. III) enumerate nearly 80 species of *Nerineæ* from the cretaceous beds. The North of Europe and America are remarkably poorly represented, and by far the largest number is known from the Alps and the Mediterranean circle. It would appear, that they were all chiefly inhabitants of southern regions, equally as the living *Pyramidellidæ* are. We shall notice three species, all belonging to the Ootatoor group of the Trichinopoly cretaceous deposits. *Ner. incavata*, Bronn, is identical with the European species; *Ner. Blanfordiana* is new, and a third species remains uncertain for the present as to its characters.

Of tertiary species two have, I think, been noticed, the *Ner. supracretacea*, Bellardi, (Mem. Soc. Géol. France, ser. II, vol. IV, p. 209, Pl. XII, Fig. 6) from the nummulitic beds near Nice, and the *Ner. serapidis*, Bellardi (Bull. Soc. Géol. France. ser. II, vol. VIII, p. 261) from nummulitic beds of Egypt. Of the latter I have not been able to procure more than the mere name, but the first has, judging from the figured section, all the appearance of a true *Nerinea*. It is evident that the specimens had all the shell surface worn off, and that consequently the plication on the outer lip is not marked. It would not be very surprising if the specimen had got into the nummulitic beds from some adjacent cretaceous strata.

11. *Criptoplocus*. Pictet, et Campiche (Mater. p. l. Pal, Suisse, 3me. ser. p. 257).

Cryp. testa conica seu pyramidali, anfractibus numerosis composita, late umbilicata; apertura quadrangulari, antice sub-effusa, postice uniplicata; labro edentulo.

The larger number of species belonging to this genus are smooth, except the *Cryptoplocus moniliferus*, D'Orb., sp., which as regards ornamentation certainly very closely resembles the *Nerineæ*. None of the species are known to have a sutural band, but so far as the shell has been observed in good preservation, it exhibits similarly curved striæ of growth, as invariably occur in *Nerineæ*. The aperture is

angular, and so far as can be seen from the direction of the striæ very slightly produced in front. There is a true umbilicus present, and the inner lip is reduced to a small posterior portion attached to the previous volution and provided with a single fold. Such great differences as these in the formation of the shell certainly necessitate the proposition of a new genus, as has been done by Pictet and Campiche; the authors equally express their opinion as to the relation of this genus with *Nerineæ*.

The present known species of *Cryptoplocus* are the following :—

Jurassic.

C. depressus, Voltz. (Bronns' Jahrb. 1836, p. 549, Pl. VI, Fig. 17), Peters, in his able paper on the *Nerineæ* of the upper Jura (Sitzungsb. Akad. Wien, 1855, vol. XVI, p. 362), draws attention to the discrepancy between Bronns' figure and description, and that of D'Orbigny, described under the same name and figure (Pl. 259) as *Ner. umbilicata* (? Voltz.) D'Orbigny. If we had to judge from mere figures, certainly the convexity of the whorls in the latter and the difference in form and position of the fold would indicate another species, which could remain,

1 *a*, under the name *Cryp. umbilicatus*, although it would not be very characteristic. I do not think, however, that Bronn's figure is quite so safe as to guarantee this alteration. All these shells, as I have already noticed, erode very much even during life-time, and convex as well as concave whorls of *Nerineæ* appear often as quite flat.

1 *b*. Zieten figures (Petrf. Wurtbg. 1830, p. 48, Pl. XXXVI, Fig. 3) a species from the coral-rag of Nattheim as *Nerinea terebra*. It is evidently a true *Cryptoplocus* allied in form, but much thinner than any known specimens of *C. depressus*; the whorls are slightly concave, and the sutural angle about 16 degrees.

1 *c*. Goldfuss (Petref. Germ. III, p. 40, Pl. 175, Fig. 7) figures another very similar form, as *N. subpyramidalis*, Münst, which agrees very much with the original *N. depressa* of Voltz. The *Nerin. depressa*, Voltz of Zeuschner (in Haidinger's Abhandlg. 1850, III, p. 137, Pl. XVI) could probably be added to this series, but it differs markedly from the others by its sutural swellings.

Quenstedt (Jura p. 765) is of opinion that most of these forms are identical, and he may be correct in this. For comparison only I had taken the proportions of the height to the diametral width of one whorl in the different forms, which had been figured, and they arrange themselves thus—

Ner. terebra in Zieten ...	... height	: width (consd. as 1·00)	= 0·47
„ *depressa* of Bronn ...	... „	„ „	= 0·39
„ „ of Zeuschner, Fig. 2 ...	„	„ „	= 0·38
„ „ „ Fig. 1 ...	„	„ „	= 0·35
„ *umbilicata*, in D'Orbigny ...	„	„ „	= 0·35
„ *subpyramidalis* in Goldfuss ...	„	„ „	= 0·34

With respect to these measurements we could justly separate at least two forms, the *Cryp. terebra*, Schübl. sp. and the other four under the name of *Cryp. depressa*, Voltz. sp., but as otherwise no well preserved specimens of all these forms, which have been referred to, are as yet known, or have not at least been examined, it would perhaps not be advisable to fix these specific alterations at present.

2. *Cryptoplocus pyramidalis*, Münst. sp. (*Nerinea* id. in Goldf. Petr. Germ. III, p. 45, Pl. 176, Fig. 11; and Peters, in Sitz. Akad. Wien, 1855, XVI, p. 361, Pl. IV, Figs. 1—3). Dr. Peters, indentifies with this species Zeuschner's *N. depressa*, but the proportions of whorls in the latter species, and of course of the animals respectively, agree rather with the *Ner. depressa*.

These proportions are as follows:—

Cryp. pyramidalis, Ner. in Goldfuss.	height	:	diametral width of a whorl (consd. as 1·00)	= 0·28
„ „ „ „ Peter's Fig. 1	„		„	= 0·28
„ „ „ „ „ Fig. 3	„		„	= 0·29

This shows clearly the difference between the measurements of Zeuschner's figures, quoted above. The present species had been first referred by Münster to the cretaceous deposits of the Gosau; its true jurassic position was, however, afterwards recognised through Dr. Peter's researches.

3. *Cryptoplocus conicus*, Stoliczka, 1867 (*Nerinea subpyramidalis*, in D'Orbigny's Pal. franç. terr. jur. II, Pl. 279). There can be no question as to the distinction of this species from Münster's *C. subpyramidalis* and Peters very properly remarks, that he is astonished how D'Orbigny could identify both. Quenstedt also says that he never met among specimens of *N. depressa* and *subpyramidalis* any such form as had been figured by D'Orbigny.

Height : diametral width (consd. as 1·00) of one whorl according to D'Orbigny's figure... 0·19

Cretaceous;

4. *Crypt. brevis*, D'Orb. sp. Pal. franç. terr. crét. II. p. 92, Pl. 162, Figs. 3 and 4.
5. „ *monilifer*, D'Orb. sp., ibid. p. 95, Pl. 163, Figs. 4—6.
6. „ *Sanctæ-Crucis*, Pict. et Camp. Mat. p. 1. Pal. Suisse, 3me. ser., p. 260, Pl. 69, Fig. 6.
7. „ *annulatus*, Sharpe, sp. Quar. Jour. Geol. Soc. Lond. 1850, VI, p. 112, Pl. XIII, Fig. 1.

The whorls of this last named species are somewhat concave; Sharpe says, however, distinctly "one fold in the interior, on the top of the whorl, curving outwards."

We cannot conclude these notes on *Cryptoplocus* without referring to a few very similar forms.

Piette described in the XII. volume of the Bull. Soc. Géol. de France, 2d. ser. p. 1114, Pl. XXXI, Figs. 5-8, a *Nerinea patella*, which agrees in the form of the shell perfectly with *Cryptoplocus*, but has one fold (tooth ?) on the outer lip.

D'Orbigny (Pal. franç. terr. jur. II, Pl. 305, Figs. 6-9) figured a *Trochus monoplicus*, which is transferred by Eug. Deslongchamps to *Niso* (vide Bull. Soc. Linn. Norm. V, p. 125, Pl. XI, Fig. 3). Certainly the species is not a *Trochus*, but I do not think it can be left in the same genus with typical species of *Niso*, for it has one distinct and strong fold on the columellar portion of the inner lip. We could quote several other examples, but it will suffice here to show that there are fossil forms of shells, which agree in every respect with *Cryptoplocus*, but some of which have one fold on the outer lip and some on the columella. Ought these forms to be separated as distinct genera, or ought the characteristics of *Cryptoplocus* to be extended to include them by allowing a change in the place of the fold ? This is a point which cannot be properly decided without a close comparison of respective well preserved shells, and without knowing the physiological and morphological importance of that fold in at least one closely allied genus. We need scarcely remark that *Cryptoplocus* has its nearest ally, as to the form of the shell, in *Niso*, and if some species (as, for instance, *C. monilifer*) did not exhibit a structure of the shell so remarkably similar to that of *Nerinea* and others, we could place it among the *Eulimidæ*; or perhaps more correctly place *Niso* and the allied genera here, instead of in the last named family. This only shows the close relationship

of the *Eulimidæ* with the *Pyramidellidæ*, and our separation may be justly considered a forcible one. There is some drawback to every attempt at classification; nothing will fit properly in the frame we try to make for nature!

Several propositions have been previously made as to the division of the *Nerineæ* into several genera, but we are certain that none based upon a *single* character, like that of Sharpe on the number of folds, can be successful. We do not pretend that we have obtained success with our present proposition, but we trust it will be found a step further on towards the solution of the problem. We believe that only a division, which is based upon the total form of the shell, but which must at the same time pay strict attention to all the other characters, as, for instance, the number and position of folds, length of the anterior canal, ornamentation, etc., can finally succeed.

XLIII. ODOSTOMIA, *Fleming*, 1848.

(Vide p. 173.)

1.—Odostomia antiqua, *Stoliczka*, Pl. XXI, Fig. 6.

Odost. testa conica, solidula, spira acuminata; anfractibus 5—6, *lævigatis atque politis, convexiusculis, regulariter crescentibus; ultimo subinflato, ad peripheriam rotundato; basi in adultis speciminibus spiraliter sulcata; apertura ovata, plica columellari sub-antica, oblique torta.*

Spiral angle 45°—50°; sutural angle 6°—8°.

The slightly convex and regularly increasing volutions appear to be specially characteristic for this cretaceous form. Young specimens are perfectly smooth; more fully grown have the basis of the last whorl spirally sulcated. The number of whorls of the species is somewhat larger than in many other *Odostomiæ* and may be said to form a transition to *Syrnola*, which is, however, still more elongated and more like *Obeliscus*.

Locality.—Garudamungalum, in a blueish calcareous sandstone; rare.

Formation.—Trichinopoly group.

XLIV. ITRUVIA, *Stoliczka*, 1867.

(Vide page 177.)

1.—Itruvia globoides, *Stoliczka*, Pl. XIV, Fig. 1.

It. testa ovato conica, lævigata, spira brevi; anfractibus gradatis; ultimo maximo, subcylindrico; apertura ovali, postice angustata; columella antice uniplicata.

Spiral angle 78°—82°.

A smooth, ovate shell, with a short spire composed of numerous volutions, which terminate abruptly at the suture. The last whorl is subcylindrical, with slightly convex outer periphery, more than twice as high as the spire, and anteriorly abruptly contracted. The aperture is ovate, posteriorly narrower, and anteriorly with one columellar fold.

When the callosity of the inner lip has been removed, there appear on such imperfect specimens some spiral striæ or plaits, which have also been noticed by Prof. Pictet in *It. truncata* (loc. cit., Fig. 4*b*). Another point worthy of notice is, that the inner space of the whorls becomes posteriorly narrower or perfectly filled up with shell-mass during the process of growth of the animal, and the consequent increase of whorls. This is the reason that the section of the aperture is so much smaller in imperfect specimens, than is the real aperture in perfect shells. Exactly the same thing can be very often observed in *Actæonella* (vide same Plate, Fig. 10).

Locality.—Comparapolliam in the Trichinopoly District; a rare shell.

Formation.—Arrialoor group.

XLV. NERINEA, *Defrance*, 1825.

(Vide p. 177.)

1. Nerinea incavata, *Bronn*, Pl. XIV, Fig. 2.

1836. *Nerinea incavata*, Bronn, Tahrb., p. 553, Pl. VI, Fig. 22.
1843. *N. incavata* et *cincta*, Münst. Golf. Petref. Germ. III, p. 45, Pl. 177, Fig. 1; and Pl. 176, Fig. 12.
1852. *N. eædem*, Zekeli, Abhandlungen der Geol. Reichs-Anst. Wien, vol. I, pt. II, p. 36.
1853. *N. eædem*, Reuss, Sitzungsb. Akad. Wien, vol. XI, p. 891.
1865. *N. incavata*, Bronn; Stoliczka, ibid, vol. LII; Revision der Gosau-Gast., p. 31.

N. testa subcylindrica, perlonga; anfractibus rectangularibus, ad medium excavatis, in junioribus ad suturam anteriorem crenulatis, in adultioribus nonnunquam paulo tumescentibus, lævigatis; fascia suturali angusta; apertura angulata, sex plicis inæqualibus instructa; duabus in columella solida positis, duabus in labio posteriori atque duabus in labro; plica anteriori semper multo fortiore quam posteriori; canali brevi, recurvo.

Height of one whorl : its width (considered as 1·00) ... ... 0·39 — 0·40.

The shell begins its growth with an angle of from 15—20 degrees. After some time, when the number of whorls increased to about 10—15, the angle decreases to 10 degrees, and still farther on the shell becomes almost cylindrical. The total number of whorls is in larger specimens 50—60. All of them are concave about the middle, and when young, the anterior margin along the suture is often crenulated; older specimens have the whorls quite smooth, only with S-form curved striæ of growth, perceptible below the narrow sutural band.

The aperture is rectangular with six folds, two respectively on the solid columella, the posterior portion of the inner lip and the outer lip; the anterior or lower fold is in each case much stronger than the posterior or upper. In cases where the aperture is preserved, all the folds, except the anterior columellar, are seen to have become obsolete.

This species was first described by Bronn, from Transylvanian specimens, of which some years ago Mr. Stur, of the Austrian Geol. Institute, collected a very fine series. On account of these materials, I have pronounced Münster's *N. cincta*

as identical with the previous species (vide Jahrb. Geol. Reichs-Anst. 1863, vol. XIII, p. 50). Münster described his *N. cincta* from the Gosau, but I never met with it, nor have I seen anywhere a specimen which had been collected in these Alpine cretaceous deposits, although there is no reason to assign, why it ought not to occur, for several of the fossils from Transylvania and the Alps are identical. The species has been lately found in the cretaceous deposits of Löwenburg in Germany. Our South Indian specimens agree perfectly with those from Transylvania, which I had compared.

In my paper, quoted above, I have also drawn attention to the similarity of *N. Conimbrica*, which had been described by Sharpe from Portugal. What Schafhæutl (Leth. Geog. Süd-Bayerns 1863, p. 389), Pl. LXV *d*, Fig. 2) describes and figures as *N. cincta*, Münst., along with most of the other determinations of this author, must first be a little better ascertained before it be admitted.

Locality.—From a conglomeratic coarse sandstone of the neighbourhood of Parully in the Trichinopoly District; rare.

Formation.—Ootatoor group.

2. Nerinea Blanfordiana, *Stoliczka*, Pl. XIV, Figs. 4-6.

Ner. testa turrita; anfractibus medio excavatis lævigatisque, margine anteriori semper tumescente atque tuberculato, posteriori ad fasciam suturalem interdum lævigato, interdum sub-tuberculato; columella, labio atque labro biplicatis, plicis anterioribus semper crassioribus; plica posteriori in labio sæpe obsoleta.

Spiral angle 20°—25°; sutural angle 3°—5°.
Height of one whorl : its width (considered as 1·00) ... 0·30—0·36

The difference in the proportions of the whorl and the greater spiral angle distinguish this species easily from the *N. incavata*, even when the preservation of the specimens is not very good. The sutural band is always very narrow, sometimes scarcely traceable. The posterior margin of each whorl is either smooth (vide Fig. 4, a very much worn specimen from a coral limestone), or, where the surface of the shell is better preserved, ornamented with large tubercles; the middle portion is concave and smooth (vide Fig. 5); the lower margin always somewhat enlarged and tuberculated. The columella is solid, and has like the posterior portions of the inner and of the outer lip each two folds, the upper or posterior ones being in each case much thinner and becoming often obsolete near the aperture.

This species resembles, as regards form and the changes in ornamentation, very much the *Nerinea Buchii*, Kefst. sp. from the Alpine Gosau formation (vide Abhand. Geol. Reichs-Anst. Wien, 1852, Vol. I. pt. II, p. 34, and Sitzungsb. Akad. Wien, 1865, Vol. LII, Revision, etc., p. 27). The European species differs by its usually hollow columella, even or much less concave whorls, and in having above the anterior tuberculated margin of each whorl a deeply impressed line, interrupted by the prolongation of each tubercle. This latter character is additional for *N. Buchii*, and has not been, I believe, previously noticed.

Localities.—W. N. W. of Moraviatoor; common in coral limestone (vide H. Blanford's Report in Mem. Geol. Surv. India, Vol. IV, pt. I, p. 90), but rare in the conglomeratic sandstone near Parully in the Trichinopoly District.

Formation.—Ootatoor group.

3. Nerinea, *sp.* Pl. XIV, Fig. 7.

Two cast specimens have been found of this species, one in the calcareous sandstones near Moraviatoor, and one in the limestones near Odium. It is remarkably conical and short, not so cylindrical as other *Nerineæ*. The section of the whorls exhibits two columellar folds, and two on the outer lip, of which, however, rather exceptionally, each posterior one is almost stronger than the lower. The posterior portion of the inner lip has only one strong fold. Towards the aperture there are on the anterior portion of the outer lip some distant impressions of three-toothed varices noticeable. By these varices the inner spaces of the aperture must have been made still narrower than would have resulted from the thickening of the other folds. No trace of the surface of the shell has been as yet found preserved. I am not acquainted with any exactly similar species, and my present object in figuring the incomplete specimen is only to draw attention to this interesting form.

Formation.—Ootatoor group.

XIX. Family—CERITHIOPSIDÆ.

(*Vide* Adams' Genera I, p. 239; Gray's Guide, 1857, p. 56.)

When we compare the animals of this family with those of the *Pyramidellidæ* and the shells with those of the *Cerithiidæ* there could be no better place assigned to it. Gray acknowledges the first relationship, but H. and A. Adams place the family altogether out of connection with any of these two. L. Reeve—Conch. Icon—says that, the shells of *Cerithiopsis* are not to be distinguished from those of *Cerithium*, and he does not consequently accept the first genus at all. This we certainly believe to be a little exaggeration. There are many particulars in the structure of the shell of *Cerithiopsis* to be noticed which appear to be characteristic for it, although much dependence is scarcely to be placed upon the form of the shell in general. Where, however, such marked distinctions have been verified, as those which are known to exist between the animals of *Cerithiopsis** and *Cerithium*, and where the respective shells are well known, it is certainly, at least with respect to these known species, not correct to disregard these distinctions, instead of being a little more patient and awaiting a more certain solution of those cases, which are as yet doubtful. The family may, therefore, be retained, but it ought to stand close to the *Cerithiidæ*.

It will be easily understood if there are already such great difficulties experienced in the determination of the recent shells, that the determination of fossil species must be much more doubtful. That forms of *Cerithiopsis*, resembling extremely

* And the sub-generic forms *Alaba*, *Diala*, *Seila* (Ann. Mag. Nat. Hist. 1861, p. 131) and probably some others.

those of the recent *Cerithia*, did exist in former times, even as far back as the jurassic period, can scarcely be questioned; but we require good materials before we can attempt to point out such slight differences, and even in such cases the fossil shells must always be carefully compared with those of the living species as regards their structure. Only in this way can we arrive at something like a correct determination of these forms.

From the cretaceous deposits merely a few North American species have been referred to *Cerithiopsis*, like *C. Morcauensis*, Meek and Hayden (Proc. Acad. Nat. Sc. Phil. 1860, p. 185), and *C. alternata*, Gabb (Pal. Calif. 1864, I, p. 116), but neither of these species is known in such a sufficient state of preservation as to warrant these determinations. Exteriorly they agree with other well known *Cerithiopsis*. We have ourselves put aside a fragment of an apparent *Cerithiopsis* from the Arrialoor sandstones near Comarapolliam. It is a small sub-cylindrical species with convex whorls, spirally striated, and transversally obsoletely costulated.

XX. *Family—CERITHIIDÆ.*

(H. and A. Adams' Gen. I, p. 283; *Cerithiadæ* Gray's Guide, 1857, p. 105.)

The animals are characterized by a broadly produced annulated rostrum; usually long, subulate, tentacles with the eyes on bulgings or short pedicles at their outer base, and by a linear lingual membrane with seven series of teeth, the central being single, hooked, and denticulated, the lateral decreasing in size towards the outer margins, and all of them multicuspid. The mantle margin has a distinct siphonal fold or a slit in front; the gills are composed of a single series of cylindrical rigid plates. The foot is short, broad, and usually well adapted for sliding. Operculum always present, horny.

The shell is turreted, generally with an elongated spire, and in the recent species covered usually with a thin, or in the fluviatile or brackish species with rather a rough epidermis; the aperture is generally channelled in front, or at least distinctly effuse: the outer lip often expanded, and externally varicose in adult specimens.

For many years past palæontologists have drawn attention to the close relationship which exists between the shells of the *Cerithiidæ* and those of *Pyramidellidæ*, specially of *Nerinea*. Since the establishment of the *Cerithiopsidæ* these relations obtained a still firmer basis in consequence of the great similarity of the animals of *Cerithiopsis* with those of *Pyramidella*, and, even as regards the usually prolonged form of the shell the former genus appears to be closely connected with the latter.

We have already, when speaking of the last two families, repeatedly referred to these relationships, and thus given expression to our views regarding the classification of the *Cerithiidæ*. The invariable existence of a distinct siphonal fold and even that of a short siphon, corresponding usually with a produced anterior canal on the aperture, entitles this family fully to the place which we assign it at the

end of the SIPHONOSTOMATA, so long as this tribe of Mollusca is retained with any regard to systematic value. We cannot perceive for what reason such distinctly canaliculated shells ought to be summarily transferred to the HOLOSTOMATA, and it seems to us that this error has been habitually introduced by a mistaken identification of the former tribe with the signification of ZOOPHAGA, and that of the latter with the PHYTOPHAGA. If this latter classification be adopted, there must be several and very considerable changes effected in the arrangement as proposed at the present. There is not, however, very much importance to be attached to either of these divisions.

H. and A. Adams proposed two sub-families, *CERITHIINÆ* and *POTAMIDINÆ*, the latter of which would form a transition to the *MELANIIDÆ*. It is usually stated, that this proposition was made on account of the paucispiral and oval, or multispiral and circular form of the operculum alone, but the mode of living of the species in both these divisions and the differences of the structure dependent upon it are far more important, the first being marine, the latter brackish or fluviatile inhabitants. The shells of the *POTAMIDINÆ* exhibit consequently many minor differences in their structure, they have generally a shorter and less deeply channelled anterior termination, a thick epidermis, etc. We fully concur with many conchologists in the desirability of keeping up this distinction into two or perhaps, according to Gray, into three families, adding the *TRIPHORINÆ*. Instead of obliterating those results, which have been obtained after much tedious work, it would be more appropriate to seek first for new facts, and to see whether these divisions could be made more practicable for the palæontologist. The same might be said with regard to the genera and sub-genera, which have been established by different authors. We restrict our remarks chiefly to the marine forms only. It is true that, so long as we are not in the possession of well preserved fossil materials, palæontologists will adhere for many years to a general name, such as *Cerithium*, but that mere name cannot continue to comprise all the great variety of forms.

a. *Sub-family—CERITHIINÆ* (*Cerithium*, auctorum).

There is not much known of palæozoic forms of the *CERITHIINÆ*, but the oldest secondary species exhibit a remarkably close relationship to *Nerinea* of the *PYRAMIDELLIDÆ*. For a number of these old *Cerithia* Piette proposed the name

1. *Fibula*, 1857 (Bull. Soc. Géol. France, Vol. XIV, p. 556). The shells are turreted, of moderate thickness, smooth or with short semi-obsolete transverse ribbings, a short canal, and contorted columella. The triassic species described and figured by Stoppani as doubtful *Nerineæ* (see Pal. Lomb. 1 ser. Pl. VII and VIII) or the *Cerithium Esinense* of the same author (ibid, Pl. XV, Fig. 11), are among others the oldest representatives of this genus. Piette notes several jurassic species from the 'Bathonien' of the Ardennes department, and others are known from the German and English Jura. In the more recent deposits these forms are much more rarely to be met with, although we know little as yet about the true character of cretaceous species, like *Cer. excavatum* (Pict. et Roux; Grès verts, Pl. XXVII, Fig. 7)

or still less of the Gosau *Rostellaria depressa*, Zek. (Abhand. Geol. Reichs-Anst. 1852, Vol. I, Pt. II, Pl. XIII, Fig. 2). Our *Cerith. detectum*, n. sp. may be another cretaceous form, belonging to this group. The *Cerith. Cassendii* and *Nostradami*, Coquand (Etage Aptien de l' Espagne, 1866, Pl. IV, Figs. 14, 15, 16), are probably true *Fibulæ*.

1. *a*.—With these chiefly smooth species there are others connected, which agree with them in form, but have usually a row of strong tubercles along the posterior suture; the tubercles being produced by a kind of insinuation in this place on the outer lip. We refer here to the jurassic *Cerith. margaritiferum*, Piette, (? d'Arch.; Bull. Soc. Géol. France. 2me. ser. XIV, p. 555, Pl. VI, Figs. 1—3), or the cretaceous *Cerith. hispidum*, Zek. (Abhand. Geol. Reichs-Anst. 1852, Vol. I, Pt. II, Pl. XXIV, Figs. 1, 2, 6, 7), which I referred to *Vertagus* (Sitz. Akad. Wien, 1865, LII, Rev. etc. p. 110), because it has a columellar fold, although it must be conceded, that the form does not agree very much with recent species of *Vertagus*. We describe two other very similar forms from South India, namely, *Cerith. hispidulum* and *inauguratum*, n. sp.

The eocene *Cerith. giganteum* belongs to this same group of species.

1. *b*.—A third series of very remarkable forms of *Cerithium* are principally cretaceous; they are distinguished by a remarkably striking resemblance to *Nerineæ*, great thickness of the shell, and transversally coarsely ribbed or tuberculated whorls. I mean under this section species like *Cerith. Haidingeri*, Zekeli (l. c. Pl. XXIV, Figs. 3, 4, 5, 8, 9), from the Alpine Gosau-deposits, or *Cerith. Sturi*, Stoliczka (Jahrb. Geol. Reichs-Anst. 1863, Vol. XIII, p. 50, Fig. 4), and others.

The sole representative of all these fossil forms among recent shells appears to be *Cerith. læve*, Quoy and Gaim. (Voy. Astrolabe, Vol. III, p. 106, Atlas Pl. 54, Figs. 1—3). It is astonishing to find this species placed by the late L. Reeve (Conch. Icon. 1866) in *Telescopium*. The author had evidently not referred to the original figure of the species in the Atlas of the 'Astrolabe', otherwise he would have found in Fig. 3 a representation of a paucispiral operculum, such as he had occasion to observe on Mr. Hanley's specimen. Quoy and Gaimard state, that they found the species at the entrance into King-George's Sound, South Australia.

2. *Eustoma*, Piette, 1855 (Bull. Soc. Geol. France, 2me. ser. XII. Vol., p. 1107, and XIII Vol., p. 99, Pl. II, Figs. 8—11), has been proposed for a jurassic turreted species with an ornamentation like the doubtful *Fibulæ* mentioned in 1*a* (vide *Cerith. hispidulum* n. sp.), but both the margins of the aperture are much expanded and posteriorly united by an indistinct canal. The considerable expansion of the inner lip distinguishes this form from *Rostellaria*, and the ornamentation of the shells agrees undoubtedly better with the *Cerithilidæ*, on which account we would prefer to classify this genus here. Besides the *Eust. tuberculosa*, Piette, another jurassic species, the *Cerith. rostellaria*, Buvignier (Stat. d. l. Meuse, Pl. XXVII, Figs. 7—9), and probably the triassic *Cerith. Donati*, Stoppani (Pal. Lomb. 3me. ser. Pl. XXVIII, Figs. 14 and 15), belong to this genus. We are not aware that any cretaceous species of *Eustoma* have been reported.

3. *Ceritella*, Morris and Lycett, 1850 (Moll. Great Oolite, Pt. I, p. 37.)= *Tubifer*, Piette, 1856 (Bull. Soc. Géol. France, 2d ser. XIII. Vol., p. 203), also proposed for a number of small jurassic shells which resemble *Actæonina* in form, the last volution being somewhat ventricose and largest, but terminating anteriorly with a short and slightly twisted canal. The whorls are either smooth or often ornamented with short transverse ribs, seldom spirally striated as usually in the *Actæonidæ*. The name *Tubifer* must yield to that of *Ceritella*, the latter having priority. No cretaceous species of *Ceritella* are as yet known, although the genus appears very numerously represented in the middle jurassic beds.

4. *Brachytrema*, Morris and Lycett, 1850 (Moll. Great Oolite, Pt. I, p. 24), including turbinate shells with usually convex whorls, ornamented by spiral striæ and transverse nodulose ribs, thus approaching already more to the typical forms of *Cerithium*. The aperture terminates anteriorly with a short canal, the columella being somewhat twisted. Piette (Bull. Soc. Géol. France 2nd Ser. XIII. Vol., p. 597) referred some of the species belonging to this genus to *Purpurina*, (*Purp. costellata*, and oth.) which genus we would rather see classed either with the *Trichotropidæ*, or with the *Littorinidæ*.

Of *Brachytrema* also no cretaceous species has been reported, but it is probable that some, like *Cerith. Phillipsi*, Leym. (Mem. Soc. Géol. France, V. page 14, Pl. XVII, Fig. 12) and a few others belong to this genus. They agree at least much better with the jurassic *Brachytrema*, than with other species of *Cerithium*, proper.

5. *Mesostoma*, Deshayes, 1864, Anim. s. Vert. Foss. du bas. de Paris, 2nd edit, II. tom., page 416) has, we believe, to be classed here, and not with the *Rissoidæ* as proposed by Deshayes. It is even very doubtful whether those species, which have suggested the new generic name, are really different from *Brachytrema*; their form is almost exactly the same as in many species of the last genus and only the fact of the transverse ribs being somewhat more numerous and less nodulose could form a distinction, if this can be really regarded as such. The shell of *Mesostoma* appears to be thinner than that of *Brachytrema*, and the columella is stated to be hollow, but *Brachytrema* has also often a fissured columella.

6. *Exelissa*, Piette, 1861 (Bull. Soc. Geol. France 2nd ser. Vol. XVIII., p. 15): *Kilvertia*, Morris, 1863 (Suppl. Monog. Gast. Great Oolite, etc., p. 15 and 93). Both names have been proposed for the same species as type, the *Cerith. strangulatum*, d'Arch., and the genus includes a large number of very characteristic, transversally ribbed species. D'Archiac in his original figure of *C. strangulatum* (Mem. Soc. Géol. France. V, Pl. XXXI, Fig. 1) restores the species as having a short anterior canal, but Piette and Morris say, that there is no anterior canal present. We are sorry that we have no good specimens of the typical *Exelissæ* to compare, but the question as to the existence or non-existence of a canal does not appear to us quite settled. We have made a few observations on a cretaceous species, *Cerith. muricatum*, Forb., which agrees in the ornamentation very much with other jurassic *Exelissæ*, and we find that in very young specimens there is scarcely a trace of a canal perceptible. The margins appear united all round.

and the aperture is oval or nearly circular and somewhat dissolute from the last volution. In full grown specimens the anterior canal is distinct, but it is almost tubular, like in *Triphoris*, and communicates with the apertural space only by a very narrow hole. When the canal is accidentally broken away, it is very difficult indeed to resume its former existence, and the aperture then appears to have had continuous margins. Taking into consideration, that of all the species which have as yet been described as *Exelissæ*, not one has been recorded with a really perfect aperture, and that nearly all of them are known from small specimens only, it should not surprise us, when a short anterior, and, as I have stated, rather a tubular canal may be proved to exist. It is of course merely a conjecture for the present, for we cannot give any decisive opinion whatever on the subject. But if there were really no trace of an anterior canal present in *Exelissa*, the genus ought necessarily to be transferred to the *Scalariidæ*, with which the posteriorly united margin of the aperture otherwise agrees.

There is a large variety of jurassic species of *cerithiinæ* known, which will most probably suggest several new generic names, as for instance the many-whorled species resembling *Turritella*, but with a distinct anterior canal; others with numerous angular whorls and somewhat of a more cylindrical shape, like some species of *Colina*, but with only a very shallow canal and expanded inner lip, similar to *Eustoma*, and others. We abstain here from any further remarks, for it is to be expected that all these forms will receive proper attention at the hands of M. Piette, who has undertaken the continuation of the jurassic Gastropoda in D'Orbigny's 'Paléontologie française.'

There is a large number of cretaceous species, which are distinguished by their conical form and flattened volutions, resembling *Elenchus* or *Bankivia* of the *Trochidæ*. They have a short contorted canal and apparently a very thin outer lip. But as we are not in possession of any complete specimens,we are contented to direct attention to this group of *Cerithium*, although it is very likely that they must be generically distinguished from others. As typical forms we would quote *Cer. ornatissimum*, D'Orb., *C. Mosense*, Buvignier, *C. Coqandi*, Pict. et Camp.; *Cer. fertile*, n. sp., and other similar forms.

7. *Sandbergeria*, Bosquet, 1860, has been proposed for a number of tertiary, ovate species, which have a very broad, shallow, but slightly prolonged canaliculation in front. If the paucispiral operculum, to which Mr. Bosquet refers, really belongs to species of this genus, it can be justly retained. Deshayes (Paris foss. 2d. edit., Vol. III, p. 112) is of opinion that, although belonging to a very marked section of *Cerithium*, the characters are not sufficient to justify a separate genus. If these shells belong to the *cerithiinæ*, that is, if the paucispiral operculum is a genuine one, they ought to be generically separated from *Cerithium*, but if it can be proved that the operculum was circular and multispiral, it would be very difficult to draw a line between *Sandbergeria* and *Cerithidea*, and perhaps *Mesalia* of the *Turritellidæ*. With regard to *Cerithidea* there is only one point which deserves attention. Looking upon the recent species of this genus it may be seen, that the

anterior canal itself is always somewhat deepened, the columella terminating abruptly on it, while in *Sandbergeria* there is no such separate canal, and the columella flattens out very gradually into the shallow depression of the margin. A reference to Reeve's Monograph of *Cerithidea* and to Deshayes' Atlas, Pl. LXXXI, Figs. 2, 6, 10, 18, a.oth., will make this clear enough. We have among the Indian fossils two species which probably belong to the section *Sandbergeria; Cer. antecedens*, n. sp. and *C. crispicans, n.* sp.

8. *Fastigiella*, Reeve, 1848 (H. and A. Adams, Gen. I. p. 155.), a turreted shell with spiral ridges, without transverse ribs, but umbilicated.

9. *Cerithium*, Adanson, 1757 (H. and A. Adams' Gen. I, p. 284).

10. *Vertagus*, Klein, 1753 (ibid, p. 285).

11. *Colina*, H. and A. Adams, 1853 (ibid, p. 286).

b. *Sub-family,—TRIPHORINÆ.*

Vide *Triphorina*, Gray's Guide, 1857, p. 108.

Triphoris, Deshayes, 1830 (Adams' Gen. I, p. 287).—It is likely, that the sub-genus *Ino*, Hinds, would form a good generic distinction, and that a good number of the slender turreted jurassic species of *Cerithium* belong to it. They would appear somewhat like not perfectly developed species of *Triphoris*, which seems also to be the case with the recent shells.

b. *Sub-family,—POTAMIDINÆ.*

We have already referred to some of the more prominent distinctions of this sub-family, and they will be found treated more in detail in any of the newer Manuals. The genera are numerous, but pretty well known, and have been lately monographed by L. Reeve in his 'Conchologia Iconica.' It is remarkable to hear this conchologist often saying, that it is very difficult to specify distinctly the characters of one or the other genus, but, when the respective species are placed beside each other, they are so similarly formed that nobody would hesitate a moment to refer the same to one genus. It is evident, that there are still some characters to be discovered in these shells, and that we have not as yet succeeded in pointing them out distinctly.

The genera usually distinguished are: *Bittium*, *Pyrenella*, *Tympanotonus*, *Potamides*, *Pyrazus*, *Telescopium*, *Cerithidea*, and *Lampania*.

Strictly speaking, the POTAMIDINÆ cannot be looked upon as anything else than CERITHIINÆ, which have been transformed and changed under somewhat different conditions, as the influence of the medium in which they lived, etc. They form in this respect a good transition to the MELANIIDÆ. It is nearly the same case, as we shall see more clearly and extensively developed in the RISSOIDÆ. It must never be lost sight of, that the POTAMIDINÆ could develope themselves only where the necessary conditions were favorable for them. On precipitous sea-coasts, where

the pure marine water has free access, they are generally wanting, while at or near the mouths of great rivers, or in brackish swamps and lakes, they are most abundant. In the fossil state we have, therefore, to look for them only in deposits formed under similar conditions. They are not wanting either in the Vienna, or in the Paris and London basins, at Ronca in Venetia, and numerous other places in the tertiary epoch (*Cerith. Duboisi*, Hörn.; *Cer. margaritaceum*, Brocc.; *Cer. elegans*, Brug., and others).

Among the secondary deposits we find the POTAMIDINÆ equally represented in cretaceous beds, and they have been traced with certainty also in the Wealden deposits. As regards the cretaceous species, I can only refer to my 'Revision of the Gosau Gastropoda' (Sitz. Akad. Wien, 1865, Vol. LII, p. 91, etc.), where I have attempted to prove that the largest number of the CERITHIIDÆ from those deposits belong to the POTAMIDINÆ. I have, however, nothing to add to this sub-family from South India.

a. *Sub-family—CERITHIINÆ.*

XLVI. CERITHIUM, *Adanson*, 1757.

1. CERITHIUM (FIBULA?) DETECTUM, *Stoliczka*. Pl. XV, Fig. 1.

Cer. testa acute turrita; anfractibus circiter septenis, altis, lævigatis, postice ad suturam paulo contractis, antice et ad medium subconvexis, varicibus nonnullis distantibus atque depressis interdum notatis; ultimo ad basim obtuse ac rotundate angulato; apertura ovata, postice acuta, antice canali brevi, contorto atque paulo lateraliter curvo terminata.

Spiral angle 24°; sutural angle 15°.

Height of last whorl	: total of shell (considered as 1·00)	0·34
Height of penultimate whorl	: height of the spire (considered as 1·00) ...	0·20*
„ „ „ „	: its width (considered as 1·00)	0·68

In the smooth surface of the shell this species agrees with the jurassic *Fibulæ*, and its recent representative *Cerith. læve*, Q. and Gaim., which, as I have already remarked, is not a *Telescopium*, although the columella is nearly quite as tortuous as in the typical *Telesc. fuscum*.

The principal characters which distinguish our cretaceous species are the comparatively great height of the whorls as to their width and the occasional slight varices, which appear on the surface, being preceded by a deep furrow. Below the sutures all the whorls are somewhat contracted, the rest being slightly convex, and the last one obtusely angulated. The aperture is ovate, considerably narrowed towards each end, anteriorly terminating with a short canal, bent laterally rather than recurved.

* If not otherwise stated I take these proportions on the back view of the shell, although the results do not very materially later if taken on the front view.

Locality.—In light coloured, gritty sandstone of Karapaudy in the Trichinopoly district; very rare.

Formation.—Arrialoor group.

2. Cerithium (Fibula?) inauguratum, *Stoliczka.* Pl. XV, Figs. 15, 19, 20.

Cerith. testa elongato-conica; anfractibus planis, spiraliter minutissime striatis, triliratis: lira posteriori juxta suturam posita, lata, crassa, 12-18 *tuberculis in uno circuitu ornata; liris anticis duabus multo tenuioribus atque minute granulosis; ultimo anfractu antice abrupte contracto; basi applanata, obsolete striata, seu lævigata; apertura quadrangulari, antice canali brevi et lateraliter curvo terminante; columella solida, biplicata, plica antica multo crassiore, postica in junioribus speciminibus obsoleta.*

Spiral angle 20°—25°; sutural angle 0°—4°						
Approximate height of last whorl	:	total of shell (considered as 1·00)	...	...	0·24	
Height of penultimate whorl	:	height of spire („ „)	...	...	0·19	
„ „	:	its width („ „)	...	...	0·44	

The more conical form, the angular and at the base less produced last whorl, the two thinner, only finely granulated, keels below a very strong one on the suture, ornamented with 12—18 tubercles, and the presence of at least two columellar plaits distinguish this species easily from *Cerith. hispidulum.* With respect to those characters, it approaches much more the Alpine-Gosau form *Cerith. hispidum,* Zek. (Abhandlg. d. Geol. Reichs-Anst., Wien, 1852, Vol. I, Pt. 2, pp. 115 and 116, Pl. XXIV, Figs. 1, 2 and 6, 7; Stoliczka, in Sitzgb. Akad. Wien, 1865, Vol. LII, Revision, etc., p. 110), but in this species only one thinner keel on each whorl and one median columellar fold is known. Unless it can be proved that both these forms show direct variations as regards these two points, they must be retained as distinct.

The more minute striation of the shell is very sharp in well preserved specimens, but it becomes easily obliterated. The tubercles show on the different keels great variations, and those on the posterior sutural keel occupy occasionally nearly half of the total height of one whorl (Fig. 20), while in other cases they are not so large, but more pointed (*vide* Fig. 19). Cast-specimens exhibit clearly the angular section of the whorls, but the columellar folds are not so easily traceable in young shells.

Localities.—Comarapolliam, Serganoor, and Karapaudy, in soft whitish sandstones; not rare at the first named locality; S. W. of Alundanapooram.

Formations.—Arrialoor and Trichinopoly groups; only the last named locality refers to the latter.

3. Cerithium (Fibula ?) hispidulum, *Stoliczka*, Pl. XV, Figs. 16, 17, 18.

Cerith. testa elongata, turrita; anfractibus regulariter in altitudine crescentibus, planis, postice prope suturam octonis seu denis tuberculis crassis atque acutis, et in tota superficie striis spiralibus granulosis ornatis, ultimis in ætate provectiore postice sæpe obsoletis; basi ultimi anfractus, convexa, paulum producta atque spiraliter striato-sulcata; apertura ovali; labio calloso, lævigato, postice plicose-dentato; canali—?

Spiral angle 25°—33°; sutural angle 4°—5°.

Height of last whorl	:	total of shell...	(considered as 1·00) ...	0·44
„ of penultimate whorl	:	height of spire („	„ „) ...	0·29
„ „ „	:	its width... ... („	„ „) ...	0·61

This species is distinguished by its strong and spinulose tubercles on the posterior margin of the whorls, the entire surface of which is covered with thin granulated spiral striæ. On the tubercles themselves these striæ become often obsolete, seldom so on the anterior flat portion of the whorls. On the produced basis of the last volution the striation and intermediate sulcation is stronger than elsewhere. The aperture could anteriorly terminate with only a short canal, but it has not been seen perfectly preserved. The inner lip is thickened, smooth, with only one elongated posterior tooth.

Localities.—S. of Serdamungalum, Kolakonuttom, and near Alundanapooram, all in soft light coloured sandstones; rather rare.

Formation.—Trichinopoly group.

4. Cerithium limbatum, *Stoliczka*. Pl. XV, Figs. 13-(14 ?)

Cerith. testa elongata, turrita; anfractibus numerosis, suturis simplicibus, interdum undulatis sejunctis, planis, spiraliter minute et granulose striatis atque in parte anteriori duabus liris tuberculatis ornatis: tuberculis 12-14 *in uno circuitu, obtusis, spiraliter paulo elongatis, transversaliter costis obsoletis junctis, varicibus crassioribus nonnullis interpositis; basi ultimi anfractus paulo convexa, spiraliter striata, ad peripheriam obsolete tuberculate-carinata; apertura rotundate quadrangulari; labio lævigato, postice unidentato; canali—?*

Spiral angle 23°; sutural angle 8°—10°.

Approximate height of last whorl	:	total of shell (considered as 1·00)	...	0·15
Height of penultimate whorl	:	height of spire („	„ „) ...	0·16
„ „ „	:	its width („	„ „) ...	0·47

A turreted subulate shell composed of a large number of flattened volutions, which are separated by simple, occasionally undulating, impressed sutures. The whole surface is covered with thin, finely granulated spiral striæ, and the anterior two-thirds portion of each whorl is ornamented with two strongly tuberculated spiral ridges, each two corresponding tubercles being transversally connected by an obsoletely marked rib, and only at some intervals by stronger varices. The ridges and tubercles are originally also striated, but these striæ are soon worn off, in which case they both

appear smooth, the tubercles being more or less rounded and somewhat prolonged in a spiral direction. The basis of the last whorl is only a little produced, slightly convex, and on the periphery bordered by an obsoletely tuberculated keel. The aperture was angular and somewhat roundish; the inner lip smooth, with an elongated posterior tooth; the canal has not been observed.

The very marked ornamentation easily distinguishes this species from others. In Fig. 14 on the same plate is represented a fragment of a large specimen from the white, soft sandstones near *Ninnyoor* (Trichinopoly district, Arrialoor group). The form of the whorls, the character of the transverse ribs and of the spiral striation agree quite with those of the above species, and are different from any other shell, which we know from the South Indian cretaceous deposits. It is difficult to say, without actual observation of intermediate forms, that the spiral tuberculated bands of *Cerith. limbatum* ought to disappear without leaving even a trace of their former existence in more fully grown specimens; that, however, similar changes do often occur in other species of *Cerithium* is well known. Still we desire by figuring the said fragment merely to draw the attention of any future observer to this very interesting fossil.

Locality.—In light coloured sandstones near Coothoor; very rare.

Formation.—Arrialoor group.

5. Cerithium carnaticum, *Stoliczka*. Pl. XVI, Figs. 1 and 2.

Cerith. testa ovate-elongata; anfractibus paucis, postice valde contractis, infra contractionem transversaliter tuberculate 8-13-costatis, spiraliter minute striatis; ultimo inflato, fere dimidium totius altitudinis testæ formante; apertura ovata, utraque extremitate attenuata; labio postice arcuato, antice prope recto atque crasso et solido; canali—?

Spiral angle about 40°; sutural angle 6°—10°.							
Height of last whorl	:	total of shell	... ...	(considered as 1·00)	...	0·48
Height of penultimate whorl	:	height of spire	(„	„ „)	...	0·37
„ „ „ „	:	its width	... („	„ „)	...	0·49

The peculiar shape of the whorls, being much contracted posteriorly and each of them ornamented below this contraction with from 8—13 short tubercle-like transverse ribs, is very characteristic for this rare species. The surface of the shell is besides covered with fine spiral striæ, which, however, become easily obliterated with age, in which case the striæ of growth appear usually more strongly marked. The last whorl is remarkably high in proportion to the total height of the shell, and similar forms to these are only to be found in the genus *Cerithium* proper, for which reason we have placed this and the following species here, although the anterior canal of either is unknown.

The aperture of the present species is oval, pointed on both ends; the outer lip could not have been much expanded, but is not known in a perfect state; the inner lip was callose, arcuated, above the middle and anteriorly nearly quite straight, solid

and very thick, as may be seen in our Fig. 1, Pl. XVI. Judging from the cast the anterior canal could have been only short and very narrow.

Locality.—Near Veraghoor, in whitish sandstone; very rare.
Formation.—Arrialoor group.

6. Cerithium vagans, *Stoliczka.* Pl. XVI, Figs. 3 and 4.

Cerith. testa ovate-elongata, turrita, anfractibus septenis seu octonis composita, altis, postice multo angustioribus, in junioribus nonnunquam sublævigatis, prope suturam paulo tumescentibus, ad medium subcarinatis, infra carinam prope rectis, transversaliter 9-11-*costatis, spiraliter postice duabus, antice ternis seu quaternis striis crassioribus atque nonnullis tenuioribus ornatis; ultimo anfractu spiræ in altitudine fere æquante; apertura ovata, postice atque antice angustata; labio calloso, postice obtuse dentato; canali*—?

Spiral angle 35°—38°; sutural angle 8°—12°		
Height of last whorl : total of shell (considered as 1·00)	...	... 0·49
Height of penultimate whorl : height of spire (considered as 1·00)	...	... 0·40
„ „ „ „ : its width („ „ „)...		.. 0·53

In some specimens the posterior or contracted portion of the whorls is often quite smooth, except a thickened margin, while in others there are two stronger and some finer spiral striæ present. On the anterior or nearly perpendicular portion there are three or four striæ with or without any intermediate ones. The transverse ribs terminate either on the middle angle of the whorls, or they are somewhat more prolonged posteriorly, but always much less marked. The aperture is considerably narrowed on both ends, and anteriorly produced; the canal has not, however, been seen perfect, but it must have been only very short. The inner lip is strongly callose, with a posterior tooth.

As to form and ornamentation this species resembles *Cerith. Stoddardi*, Hislop, from the so called intertrappean beds near Rajamundry (Quar. Journ. Geol. Soc. Lond., XVI, p. 177, Pl. VIII, Fig. 35). It differs from that species chiefly by the unequal strength of the spiral striæ and by having the transversal tubercles on the different volutions corresponding to each other in almost perpendicular lines, while in *Cerith. Stoddardi* the tubercles correspond to each other in very oblique lines and the spiral striæ are more numerous and almost all of the same thickness.

Localities.—Garudamungalum, in a blueish, calcareous sandstone, and Karapaudy, in whitish, soft sandstone; rare.

Formations.—Trichinopoly and Arrialoor groups.

7. Cerithium Arcotense, *Stoliczka*. Pl. XV, Figs. 2—5.

Cerith. testa conica, elongata, spira subulata, in medio atque antice subcylindrica; anfractibus numerosis, planiusculis, liris spiralibus alternatim crassioribus atque costulis transversalibus obliquis granulosisque ornatis, ultimis varicibus plus minusve numerosis interruptis, granis in serie posteriori juxta suturam positis multo fortioribus quam ceteris et nonnunquam linea impressa spirali rursus divisis; costulis lirisque infra seu antice semper tenuioribus atque interdum in anfractibus ultimis omnino obsoletis; apertura ovali, in utraque extremitate angustata; labro paulo expanso, extus varicoso, intus lævigato; labio postice uni-dentato; canali brevi atque angusto.

Spiral angle 25°—30°; sutural angle 12°—13°		
Height of last whorl	: total of shell (consd. as 1·00)	0·31
Height of penultimate whorl	: height of the spire (consd. as 1·00) ...	0·17
„ „ „ „	: its width (consd. as 1·00)	0·54—0·58

This elongated conical shell consists always of a large number of flattened volutions, the first few of which form a subulate apex, and begin to grow with an angle of 25—30 degrees, becoming subsequently almost cylindrical in shape. Each of the whorls is ornamented with a number of oblique, transverse ribs, interrupted at some distances by thicker varices, and with four or five spiral striæ, which usually alternate in their strength, and produce a granulation on the former. The posterior series of these granules is always the strongest, the following series become gradually smaller, and towards the last volution all the ornamentation gets often more or less obsolete. The last whorl shows occasionally a little irregularity in its coiling by descending somewhat lower. The aperture is oval, posteriorly acute, and considerably narrowed by a strong fold-like tooth on the inner lip, and terminating anteriorly with a short, slightly bent canal. The outer lip is somewhat expanded, and thickened exteriorly so as to form a varix.

This species has rather more the general form of *Vertagus*, but there is no trace of a fold on the columella, which is only sharpened where it terminates on the anterior canal. It approaches in ornamentation and form very much to the *Cerith. rude*, Sow. (D'Archiac, Gr. Numm. de l'Inde, p. 299, Pl. XXVIII, Figs. 9—12) from the nummulitic deposits of Scinde. The latter species has, however, the transverse ribs nearly always equally strong in their total length, and the tubercles are more rounded than spirally elongated.

Localities.—N. E. of Anapaudy (white sandstones); near Veraghoor (yellowish sandstones); and near Coothoor, in a whitish siliceous sandstone; very common.

Formation.—Arrialoor group.

8. Cerithium lassulum, *Stoliczka*. Pl. XV, Fig. 8, Pl. XIX, Fig. 1.

Cerith. testa turrita; anfractibus numerosis, planulatis, sutura profunda sejunctis, spiraliter minute striatis atque seriebus ternis tubercularum fere æqualium ornatis, in interstitiis paululum crenulatis; basi ultimi anfractus applanata, spiraliter striata, ad peripheriam carinata; apertura rotundate-angulari; canali brevi?

Spiral angle 21°; sutural angle 10°.
Height of one whorl : its width (considered as 1·00) ... ... 0·5.

There are two cretaceous species known, which greatly resemble our Indian fossil in ornamentation, namely, *Cerith. ternatum*, Reuss (Boehm. Kreide. 1845, pt. I, p. 42, Pl. X, Fig. 3), and *Cerith. sociale*, Zek. (Abhandlg. Geol. Reichs-Anst. Wien, 1852, Vol. I, Pt. II, p. 95, Pl. XVII, Figs. 4 and 6; Stoliczka, in Sitzungsb. Akad. Wien, 1865, LII, Revision, etc., p. 95). Of the former, which is from the Bohemian cretaceous deposits, Prof. Reuss says, that the middle row of tubercles is stronger than any of the others, while in our specimen they are nearly equal in strength, the lowest being comparatively the strongest. The sutures are also much wider in our species, and the entire shell is covered with fine spiral striæ, of which, however, often only one between each row of tubercles remains preserved, and occasionally they all disappear.

The *Cerith. sociale* is from the Alpine Gosau-deposits, and differs by its more slender form, posteriorly abruptly terminating whorls, and produced basis of the last, being ornamented with three or four strong ridges.

Locality.—Vylapaudy, in yellowish sandstones; very rare.

Formation.—Arrialoor group.

9. Cerithium clarandum, *Stoliczka*. Pl. XV, Fig. 10.

Cerith. testa subulata; anfractibus numerosis, sutura angustissima sejunctis, planis, spiraliter ternis liris acutiusculis, transversaliter 12-14 *costulis decussantibus atque tubercula spinulosa formantibus ornatis; liris aliquantisper striis tenuissimis alternantibus; apertura quadrangulari.*

Spiral angle 17°; sutural angle 7°.
Height of one whorl : its width (considered as 1·00) ... ... 0·32

The ornamentation of this species is so characteristic that, imperfect as the specimen is, it can be easily recognised. Generally there is only one thin intermediate line between the two lower or anterior ridges, and one above the posterior running along the suture. There is, however, from the same locality another larger but less perfect specimen, which has four equally strong and closely placed spiral ridges, and the transverse ribs somewhat stronger on each whorl. The uppermost volutions are not preserved, the spiral angle of the lower ones is 22°. It is difficult to say whether this form depends only upon a variation in the surface markings, or whether

these indicate another species, which would somewhat resemble *Cerith. Requienianum*, D'Orb. (Pal. Franç. crét. II. Pl. 232, Figs. 4 and 5). The latter supposition is more probable. I could only recall on this occasion D'Orbigny's *Cerith. Fontanieri* (Astrol. Pal. Pl. IV, Fig. 2) from Pondicherry, in which species the spiral striæ are still more numerous.

Locality.—Anapaudy, in yellowish calcareous sandstone; very rare.

Formation.—Trichinopoly group.

10. Cerithium trimonile, *Michelin.* Pl. XV, Fig. 9, and Pl. XIX, Figs. 2 and 3.

1838. *Cerith. trimonile*, Mich. Mem. Soc. Géol. France, Ire. ser. Vol. III, p. 100, Pl. XII, Fig. 5.
1842. „ „ „ D'Orbigny, Pal. Franç. crét. II, p. 369, Pl. 230, Figs. 7—9.

Cerith. testa turrita, apice subulata; anfractibus complanatis, spiraliter minute striatis atque ternis seriebus tuberculorum ornatis: tuberculis in serie mediana sæpius ceteris minoribus, serie superna vel posteriore interdum sulca profunda duabus inferioribus sejuncta, tuberculis in serie antica sæpissime maxime elevatis; basi ultimi anfractus subconvexa, moderate producta, spiraliter striata; apertura quadrangulari, antice canali contorto sed angustissimo terminante; labio lævigato.

Spiral angle 25°—30°; sutural angle 4°—5°				
Height of last whorl	: total of shell	... (considered as 1·00)...	...	0·32
„ of penultimate whorl	: height of spire (	„ „ „)...	...	0·24
„ „ „	„ : its width ... (	„ „ „)...	...	0·17

A small subulate shell composed of numerous flattened volutions, which increase very gradually and regularly in height and width. Each of the whorls is ornamented with three rows of small, rounded, and closely-set tubercles. In young specimens the uppermost or posterior row is always distinctly separated by a deep furrow, while the tubercles in the two others approach so very nearly to each other, that they seem to form short transversal ribs. In larger grown specimens this furrow remains either equally distinct or becomes more obliterate. The middle row has generally the smallest and the anterior the largest tubercles. Very seldom the tubercles of the two anterior rows are nearly equal, and not so strong as those on the posterior. Besides these tuberculated ridges the entire shell-surface is minutely striated. The canal is contorted and tolerably produced; the aperture quadrangular and the lips smooth.

Michelin's original figure is not very clear. D'Orbigny figures a specimen in which the tubercles of the posterior row are the smallest, and of which the spiral angle is 32°; the first case has never been observed in our specimens, and their largest spiral angle does not exceed 30°. In every respect, however, our specimens are identical with originals from the Gault of Yonne, transmitted to us very kindly by Prof. Pictet. It adds very much to the interest of our fauna, that this characteristic Gault fossil occurs also in the South Indian cretaceous deposits. It belongs here to the highest group of the series. The species is common in the Gault of France, and has also been found near Folkstone.

Localities.—N. E. of Karapaudy and N. of Comarapolliam, in whitish siliceous sandstones; not very common.

Formation.—Arrialoor group.

11. Cerithium fertile, *Stoliczka.* Pl. XV, Figs. 11 and 12, and Pl. XIX, Fig. 5.

Cerith. testa conica; anfractibus paulo excavatis, spiraliter minute-striatis, antice et postice atque prope medium crenulate-carinatis: carina suturali posteriori multo fortiori, mediana minima; apertura quadrangulari, antice canali brevi terminante; labio lævigato; columella contorta.

Spiral angle about 40°; sutural angle 1°—4°			
Height of last whorl	: total of shell (considered as 1·00)	...	0·28
„ „ penultimate whorl	: height of spire (considered as 1·00)	...	0·15
„ „ „ „	: its width („ „ „)	...	0·14

This species is one out of a large number of very similar forms known from the cretaceous deposits of Europe, namely, *Cerith. Derignyanum, Rhodani, and Sabaudianum,* of Pictet and Roux., *Cerith. Mosense,* Buvignier, *Cerith. ornatissimum,* D'Orb., *Cerith. Chavannesi,* Pictet and Campiche, and some others. The nearest allies are certainly *Cerith. Mosense* and *ornatissimum,* which are stated by Pictet to be undoubtedly different species (*vide* Mat. p. l. Pal. Suisse, ser. III, p. 294). From both these, certainly very similar species, our Indian fossil differs by a greater height of the whorls as compared with their respective width. The spiral angle approaches very nearly, or is often exactly, the same as in *Cerith. ornatissimum.* There is no marked difference between the posterior keels of the two species. But while in *C. ornatissimum* the anterior keel separates a small distance from the suture, when on the last whorls approaching the aperture, the same is in *Cerith. fertile* always strictly sutural, but much stronger than the anterior; and in addition to the middle keel there is a fourth one present, and quite distinct in young specimens, gradually becoming obliterate in older. (*Vide* Pl. XIX, Fig. 5.) These differences are therefore greater than those between the two above-mentioned European species.

It is important also to mention the Transylvanian species, which I have noted as *Cerith. rotulare* in the Jahrb. Geol. Reichs-Anst. Wien, 1863, Vol. XIII, p. 51. This species is a much more slender form, and differs from *Cerith. Mosense* apparently only by the very considerable thickness of the shell and more concave whorls.

Casts of *Cerith. fertile* are quite smooth; the aperture is quadrangular, wider than high, terminating anteriorly in a short, laterally bent canal.

Locality.—N. of Odium, in yellowish, calcareous sandstone with *Am. inflatus, dispar,* and others.

Formation.—Ootatoor group. It is interesting to see that this species occurs with precisely the same association of *Ammonites* as the similar forms to which I alluded occur in Europe, while their other associate Gault-species, *Cerith. trimonile,* has as yet been found in India only in the highest beds.

12. Cerithium (Exelissa?) scalaroideum, *Forbes*. Pl. XV, Figs. 6 and 7.

1846. *Cerith. scalaroideum*, Forbes, Trans. Geol. Soc. Lond., ser. II, vol. VII, p. 125, Pl. XIII Fig. 7.

Cerith. testa turrita; anfractibus circiter denis, planatis, suturis latis atque profundis sejunctis, transversim 14-16-*costulatis, spiraliter* 4-*liratis: liris tenuibus atque in costulis tubercula plus minusve elata seu acuta formantibus; superficie omnina spiraliter minutissime striata; costulis prope aperturam in striis numerosis elevatis dissolutis; apertura circulari, marginibus conjunctis, paulo elevatis, antice canali brevi atque angustissimo, contorto terminantibus; basi ultimi anfractus prope peripheriam bicarinata, ad medium excavata atque prope terminationem canalis unicarinata; carinis omnibus crenulatis, crassis.*

Spiral angle (on the top whorls only) 30°—32°; sutural angle 12°—14°

Height of last whorl	:	total of shell (considered as 1·00)	... 0·42
„ of penultimate whorl	:	height of spire (considered as 1·00)	... 0·25
„ „ „ „	:	its width („ „ „)	... 0·47

The shell begins to grow with an angle of about 32°, but after it has reached a certain size, the whorls do not increase to the same extent proportionally in width, and the form becomes therefore more cylindrical. The transverse ribs are always thin, oblique in the direction of the outer lip, and near the aperture they become replaced by a large number of merely elevated lines. Their number varies between 12 and 16; 14 being about the usual number. Spiral ridges seem to be always only four; the tubercles, which are formed by them in crossing the transverse ribs, are generally sharpened and pointed, seldom they appear so much rounded, as represented in our Fig. 6, Pl. XV. The entire surface of the shell is minutely spirally striated. The aperture is circular, its margins somewhat elevated and separated from the other shell, forming a kind of a tube and terminating anteriorly with a short, contorted, and exceedingly narrow canal.

I need scarcely repeat here again, what I have already stated at length about Piette's genus *Exelissa*. The only species that has really a very great resemblance to our Indian fossil is one figured and described by Reuss (Boehm. Kreide. 1846, Pt. I, p. 42, Pl. X, Fig. 5, and Pl. XI, Fig. 22) as *Cerith. reticulatum* (? Sow.*) from the cretaceous conglomerate of Meronitz in Bohemia. I would almost believe that they are identical. Geinitz identifies that *C. reticulatum* of Reuss with *Cerith. imbricatum*, Geinitz,† (*vide* Quadersandsteingebirge, 1849-50, p. 142), but upon a reference to Geinitz's original figure in his "Characteristic des Sæchs. Boehm. Kreidegeb." Pt. III, 1842, p. 72, Pl. XVIII, Fig. 22, such an identification is very objectionable, unless Geinitz's figure be quite incorrect. This specimen of *Cer. imbricatum* has the whorls separated by very narrow sutures, the transverse ribs are

* The name *C. reticulatum* has been used repeatedly by several authors, as *Montagu, Risso, Deslongchamps*, a. o.

† This name cannot stand, for it has been equally used a long time ago by Bruguiere, Bonelli, and others. Münster's *Cerith. imbricatum* (in Goldf. Pet. Germ.) is called by Geinitz, *C. Goldfussi* (non *idem*, Zekeli,)=*C. reticosum*, Sow. (*vide* Stoliczka in Sitz. Akad. Wien, 1865, Vol. LII, Revision, etc., p. 97). D'Orbigny, in Prodrome II, p. 231, calls the same *C. sub-imbricatum*.

very broad, the spiral ridges close to each other and more numerous. Geinitz's description is not clear on these points. I am unable to refer to Woodward's Geology of Norfolk, which Prof. Reuss quotes, but I cannot find that name of Sowerby in D'Orbigny's, Bronn's, or Morris' catalogues.

Localities.—Near Alundanapooram, in blueish calcareous and shelly sandstones; the species is rare, but it occurs oftener near Arrialoor and Comarapolliam in whitish soft sandstones. From a similar sandstone there are two specimens labelled in the Madras Museum as from Pondicherry; if so, they must have been got there from the upper or Arrialoor beds, pointed out by Mr. H. Blanford.

Formations.—Trichinopoly and Arrialoor groups; to the former the first named locality refers.

13. Cerithium (Sandbergeria) antecedens, *Stoliczka.* Pl. XVI, Fig. 5, and Pl. XIX, Fig. 4.

Cerith. testa turrita; anfractibus denis seu duodenis, convexis, transversaliter obsolete costulatis spiraliter liratis: liris medianis tenuioribus alternantibus atque omninis in costulis transversalibus spinulosis seu subtuberculatis; apertura ovate-rotundata, antice paulo producta atque late effusa, marginibus integris, parum dilatatis, intus lævigatis; labro extus varicoso.

Spiral angle 40°—42°; sutural angle 4°—5°

Height of last whorl	:	total of shell (considered as 1·00)	0·40
„ of penultimate whorl	:	height of spire (considered as 1·00)	0·30
„ „ „ „	:	its width (considered as 1·00)... ...	0·48

The transverse ribs are always very thin, and often only apparent through the fine tubercles, which are formed by the spiral striæ. Of the latter six are generally stronger, and except those running along either of the sutures the others alternate with finer striæ. Those on the greatest convexity of the whorls are, generally speaking, the strongest. The margins of the aperture are united posteriorly, somewhat expanded, internally smooth; and the outer lip is externally varicose. A second varix is occasionally preserved in larger grown specimens, and placed at about two-thirds the distance of the volution from the aperture. On the place of the anterior canal the margins are only somewhat produced and form a broadly effuse channel.

An allied species is *Cerith. Lallierianum*, D. Orb. (Pal. Franç. crét. II, Pl. 229, Figs. 7-9), which differs merely by stronger transversal ribbings, somewhat more numerous spiral striæ and more produced anterior canal. Forms very similar to the Indian fossil are to be found among living American and Indian species of *Cerithidea*, like *C. Mazatlanica*, Carp., *C. Mörchii*, Adams, *C. iostoma*, Pfeiff., and others (*vide* Reeve, Conch. Icon., Monog. of *Cerithidea*, 1866); we have, however, already referred to the probable distinctions between *Sandbergeria* and *Cerithidea*.

Localities.—Karapaudy, N. E. of Shillagoody, and east of Andoor, in soft conglomeratic sandstones.

Formation.—Arrialoor group.

14. Cerithium (sandbergeria ?) crispicans, *Stoliczka*. Pl. XVI, Figs. 6—8.

Cerith. testa turrita; anfractibus octonis seu denis, convexis, transversaliter 10-18*-costulatis, spiraliter liratis: costulis in speciminibus adultis plus, in junioribus minus numerosis; liris in quoque anfractu, septenis seu nonis nonnunquam fere æqualibus, sæpius nonnullis alteris multo tenuioribus alternantibus, paulo undulatis seu crispatis; apertura ovata antice effusa; labio lævigato, tenui.*

Spiral angle 30°—35°; sutural angle 7°—8°							
Height of last whorl	:	total of shell	...	(considered as 1·00)	...	...	0·42
„ of penultimate whorl	:	height of spire	(„	„ „)	...	...	0·31
„ „ „	:	its width ...	(„	„ „)	...	...	0·44

A small turreted shell, which numbers from eight to ten convex whorls, each being ornamented by 10-18 transverse ribs and 7-9 spiral, sharp, and slightly undulating ridges. In young specimens the ribs are less numerous, and increase gradually with the size of the whorls. The spiral ridges are sometimes nearly equal, but more frequently some of them, especially the middle ones, alternate with finer ridges, which also cover the basis of the last volution.

The aperture is oval, anteriorly somewhat produced and effuse. It has not been seen quite perfect in a full grown specimen. The small one represented on Plate XVI, Fig. 6, although having the shell surface somewhat obliterated, has a thin but distinct varix on the outer lip externally; no varix has been observed on any of the preceding whorls. The inner lip is comparatively thin and smooth.

Until good and full grown specimens of this species have been found, its determination as *Sandbergeria* must remain doubtful, although the great similarity between the same and the *Cerithium antecedens* makes it very probable. I am not acquainted with any cretaceous species which could strictly be compared with the above.

Localities.—East of Alundanapooram and near Arrialoor, in soft, whitish sandstones; rare.

Formation.—Arrialoor group.

II. *Tribe*,—Holostomata.

Under the name of Holostomata are included those *Ctenobranchiate Gastropoda, which have an external, calcareous, cup-shaped or spiral shell, the aperture of which is not anteriorly produced into a canal, and very rarely emarginated, or indistinctly notched; having, as a rule, an uninterrupted margin in front; the spiral shells possess generally a horny or calcareous operculum.*

Although the animals of the Ctenobranchiata holostomata often closely resemble those of the Ct. siphonostomata, they are very rarely provided with a prolonged respiratory sipho. A large number of them, however, have in its place a more or less distinct siphonal fold in the anterior margin of the mantle. Upon the development of this fold depends, to some extent, the formation of the anterior portion of the aperture in the shell. Thus, while most of the Holostomata, as stated, have the margin of the aperture in front entire, we find among the *Melanopsinæ* (of the family *Melaniidæ*) and among the *Planaxidæ* specimens, which have the aperture anteriorly more distinctly emarginated, than many *Cerithiidæ*, though the siphonal fold itself is hardly so well marked, as in the last named family. The *Eulimidæ*, *Solariidæ*, and others have, under similar circumstances, the aperture only slightly produced without a notch or an emargination. The development of a long sipho in *Ampullaria*, not being connected in any way with the usual emargination of the aperture, appear somewhat anomalous, and is probably due to the peculiar mode of living. These and similar cases, concerning other parts of the organisation of the animals, and the formation of the shells, exhibit clearly the shortcomings of the system here adopted. It is hardly necessary on my part to repeat, what I have previously stated, namely, that I regard this entire classification of the Prosobranchia merely as a temporary one. It is far from natural; but I have retained it (though with some modifications in the arrangement and characteristics of the different groups), because it has for the palæontologist certain advantages, which are at the present not easily obtained from other systems, based solely upon the dentition. The exceptions from the general characteristics of the orders, tribes, and other groupings, are not so numerous, as would require to be recorded in the systems of Gray, H. and A. Adams, and others.

Tracing out the Geological history of the Ctenobranchiata, the Holostomata must be regarded as much older than the Siphonostomata. For while the latter appear only very sparingly at the beginning of the mesozoic period, the former were already tolerably numerous in the palæozoic, and have probably their maximum in the first half of the former.

Looking at the general results of the palæontological researches, according to which the older forms in the different classes of animals are generally lower in organisation, the early appearance of the Holostomata agrees tolerably well with their lower place in the system. This classification is partly supported by the somewhat defective development of their organs of locomotion, respiration, the uniformity of dentition, of generation, &c., in many families or groups, as compared with those of the Siphonostomata.

On the contrary, however, ascending through the orders of the Gastropoda from the PROSOBRANCHIA to the NEUROBRANCHIA and the PULMONATA we see, that the nearest resemblances between the animals and shells of the two last named and the first order are to be found almost exclusively among the HOLOSTOMATA. These are in fact more than simple resemblances, as we shall have occasion to notice in the family of the *RISSOIDÆ* and others, where transitions from marine to freshwater and terrestrial shells seem traceable with no great difficulty. Such series of changes, when once they have been sufficiently studied and established by direct observation, will produce the most extensive alterations and improvements in our present defective systematical arrangements.

In a similar manner, as we have already done with the SIPHONOSTOMATA, and in continuation of the last families of that tribe, we shall endeavour to arrange the families of the HOLOSTOMATA according to their respective affinities, and shall notice them in the following order:—

21. *Family.—MELANIIDÆ, (PALUDOMINÆ, MELANOPSINÆ, MELANIINÆ* and *STREPOMATINÆ).*
22. „ *—TURRITELLIDÆ.*
23. „ *—SCALIDÆ.*
24. „ *—CÆCIDÆ.*
25. „ *—VERMETIDÆ.*
26. „ *—SILIQUARIIDÆ.*
27. „ *—ONUSTIDÆ.*
28. „ *—SOLARIIDÆ.*
29. „ *—PLANAXIDÆ (PLANAXINÆ* and *LITIOPINÆ).*
30. „ *—LITTORINIDÆ (LACUNINÆ* and *LITTORININÆ).*
31. „ *—AMPHIBOLIDÆ.*
32. „ *—VALVATIDÆ.*
33. „ *—AMPULLARIIDÆ.*
34. „ *—VIVIPARIDÆ.*
35. „ *—RISSOELLIDÆ.*
36. „ *—RISSOIDÆ* (with sub-families *TRUNCATELLINÆ, POMATIOPSINÆ, BYTHINIINÆ, HYDROBIINÆ, SKENEINÆ, RISSOINÆ, RISSOININÆ).*
37. „ *—EULIMIDÆ (CHEMNITZIINÆ, EULIMINÆ* and *STYLIFERINÆ).*
38. „ *—NATICIDÆ (TYLOSTOMINÆ, NATICINÆ* and *SIGARETINÆ).*
39. „ *—VANIKORIDÆ.*
40. „ *—VELUTINIDÆ.*
41. „ *—JANTHINIDÆ.*
42. „ *—CALYPTRIDÆ.*
43. „ *—CAPULIDÆ.*
44. „ *—TECTURIDÆ.*
45. „ *—GADINIDÆ.*
46. „ *—LEPETIDÆ.*
47. „ *—SIPHONARIIDÆ.*

By far the largest number of the HOLOSTOMATA belonging to the above-named families, (with few exceptions, *NATICIDÆ*, probably *SCALIDÆ*, and others) are vegetable feeders; their teeth are usually small and numerous, for which reason they are classed by Dr. Gray and others in the divisions PTENO-and TÆNIO-GLOSSATA.

The animals inhabit the sea, a few being oceanic, but most of them are littoral forms; some live in freshwater, while a small number are even enabled to maintain their existence, for a time at least, in a moist atmosphere. In the present epoch the tribe of the HOLOSTOMATA does not equal in number that of the SIPHONOSTOMATA, having, as already stated, had its maximum of development in former geological periods.

XXI. *Family,—MELANIIDÆ.*

Sub-families,—MELANOPSINÆ, MELANIINÆ, STREPOMATINÆ, and *PALUDOMINÆ.*

H. and A. Adams, Genera I, p. 293; *MELANIADÆ*, Gray, Guide, 1857, p. 101; Chenu's Man. I, p. 268; *MELANIANA*, Lam., Deshayes, Paris foss., 2nd edit., vol. ii, p. 441.

Dr. Brot,* who has made the family of the *Melaniæ* his special study, unites in it all the *turbinate freshwater shells, which have the margins of the aperture not united, and possess a horny, spiral, or concentric operculum.* The same author retains only the following genera, *Paludomus*, Swain. (incl. *Tanalia*, *Ganga*, and *Philopotamis*); *Leptoxis*, Raff.; *Melania*, Lam.; *Io*, Lea; *Melanopsis*, Fer.; *Hemisinus*, Swain.; *Gyrotoma*, Shuttlw.; *Pirena*, Lam. These genera could be easily arranged into four sub-families, those of the *PALUDOMINÆ*, being specially characteristic for Ceylon and the East Indies; the true *MELANIINÆ*, including the Melanias of the old world, the animals of which have the mantle margin fringed; the *STREPOMATINÆ*,† embracing the American species of *Melania*, the animals of which have the mantle simple, and the operculum subspiral, and at last the *MELANOPSINÆ*, the shells of which are anteriorly truncate or emarginated.

Many of the sub-genera quoted by H. and A. Adams, Chenu, Tryon, and others, seem to form desirable sub-divisions in these sub-families, while others, like *Lionella*, are justly considered as doubtful, and probably not belonging to this family at all.

True *MELANIIDÆ* are first known from the 'Wealden' with certainty, though some of the species from the coal-beds of the lower Jurassic formations may be still earlier representatives. The characteristic fossils of the freshwater deposits of the cretaceous formations are as yet very imperfectly known. Some additions may, however, be soon expected from the latest researches of Hebert, Vilanova, Verneuil and others in the Western Alps and in Spain.

For the present I am acquainted only with the small number of species described by myself from a cretaceous freshwater deposit in the North-eastern Alps (vide Sitzb. Akad. Wien, 1860, Vol. XXXVIII, pp. 483, etc.), including some

* Catalogue systematique des especes qui comp. la fam. des Melaniens, Genéve, 1862.

† Vide Haldeman on *STREPOMATIDÆ*, etc., in Proc. Acad. Nat. Sc. Philadelphia, 1863, p. 273, and Tryon, *ibidem*, p. 306, etc.,—also Gill, in Proc. Phil. Acad. 1863, p. 34, proposing a new genus *Faunopsis* in the fam. *MELANOPSIDÆ*, and Lea, *ibid.* 1864, p. 2, proposing a new genus under the name of *Meseschiza*.

subsequent additions, noticed in my revision of the Gosau-Gastropoda (ibid. 1865, Vol. LII); they are the following, *Melanopsis, lævis, punctata,* and *dubia; Melania granulato-cincta,* and *Beyrichi,* Zek. sp.; *Tanalia acinosa,* Zek. sp., and *T. spiniger,* Sow. sp.

In a recent number of the 'Verhandlungen d. geol. Reichs.-Anst.', Wien, 1866, Vol. XVI, p. 208) appears a notice by Mr. H. V. Hantken, stating that cretaceous freshwater deposits, similar to those in the North-eastern Alps, have likewise been discovered near Ajka in Hungary (Comitate Veszprim). Besides several of the identical species, quoted above, five others have been found, which are considered by Mr. Hantken to be new.

A *Melania (Potadoma) veterna,* Meek and Hayden, is described from the cretaceous rocks of Nebraska in Proc. Acad. Nat. Sc. Phil. for 1861, p. 444.

In our deposits of South India no species of the *Melaniidæ* has yet occurred.

Tertiary species are numerous and known from all parts of the world, but the maximum of their development falls in the present period.

XXII. *Family,—TURRITELLIDÆ.*

H. and A. Adams, Gen. I, p. 350; Chenu, Man. I, p. 315; *Turritelladæ,* Gray, Guide, 1857, p. 109, and others.

Animals with the mantle-margin partially fringed or simple, but generally with an obsolete, anterior fold; foot short, not much expanded, roundish; operculigerous lobe simple; branchial plume single, consisting usually of long pectinations and with some mucous fillets; rostrum short, not retractile; eyes on small bulgings on the outer bases of lengthened, subulate tentacles; lingual membrane very narrow and short; teeth placed in seven series, the central being single, hooked and denticulated, the lateral narrower and with longer, angularly bent tips, but otherwise similarly denticulated. Operculum horny, circular, multispiral.

Shell turreted, spiral, many-whorled, with gradual increase in thickness; aperture roundish with thin margins, anteriorly often sub-effuse; the outer lip is usually insinuated posteriorly and somewhat produced anteriorly.

The *Turritellidæ* are at the present time without exception inhabitants of the sea. In many details of their organization they resemble closely the *Melaniidæ* as well as the *Cerithiidæ,* while, on the other hand, they pass into the *Cæcidæ* and *Vermetidæ.* The form of the shell approaches very much to that of the *Scalidæ,* and thus everything seems to be in favor of their classification,* as intermediate between the two last named families.

* Deshayes (Anim. s. vert., Foss. bas. Paris, 2nd ed., Vol. II, p. 306) appeals to the opinion of all conchologists with regard to what he views as H. and A. Adams' unjustifiable classification of the *Turritellidæ* after the *Ampullariidæ.* The relations pointed out as existing between the former family and the *Cæcidæ* appear to Deshayes nothing more than accidents, upon which the 'authors of the Genera' hit!—If M. Deshayes had been able to consult Semper's remarks on the genus *Mathilda,* his criticism also on the relations of the *Scalidæ* and *Pyramidellidæ* (in part) would very likely have been less severe.—We cannot argue as to how far our present classification is natural, but it must be admitted, that one cannot see anything more unnatural between the *Turritellidæ* and *Ampullariidæ* in H. and A. Adams' 'Genera,' than between the *Valvatidæ* and *Solariidæ* in Deshayes', 'Paris fossils.'

A good deal of difference exists in the opinions of conchologists with regard to the number of genera, into which the family ought to be divided. Though H. and A. Adams have attempted to distinguish a number of genera and sub-genera, it is indeed extremely difficult to follow this division into detail, even when restricted to the recent species alone. Our information as to animals and shells must be much increased before we can insure success on this point. The difficulty becomes, however, considerably greater when we enter upon the determination of the fossil species. It cannot be said that the *Turritellæ* belong to the number of rare fossils, but they are often met with in a deficient state of preservation.

From the recent *Turritellidæ* we can select only a small number of forms, characteristic enough to be acknowledged as separate genera; the larger bulk of them we would prefer for the present to note merely under sub-generic divisions of Lamarck's genus *Turritella*. Deshayes offered lately (Paris foss. 2nd edit., Vol. II, p. 305, etc.) some valuable remarks upon the family, in which he distinguishes only three genera, *Proto*, Defr. (*non* Leach and oth.) *Turritella* and *Scalaria*. The last of these, including *Eglisia*, will in conformity with the opinions of other conchologists be classified under a separate family, (vide p. 228).

The following may serve as a short review of the genera, which according to the present state of knowledge constitute the family *Turritellidæ*:—

1.—*Glauconia*, Giebel, 1852.

1826? *Proto*, Defr. (? 1824) (non *idem*, Leach or Oken).
1852. *Omphalia*, Zekeli, (non *idem*, Haan).
1852. *Glauconia*, Giebel, Allgem. Palæont., p. 185.
1866. *Cassiope*, Coquand, (Mon. Pal. de l'étage aptien de l'Espagne, p. 57) (non *idem* seu *Cassiopea*, Don, et cet.).

Prof. Coquand proposed lately the name *Cassiope* in place of *Omphalia*, but the former has been already used in a different sense, and I find, that Prof. Giebel has proposed the name *Glauconia* in the same year, as Zekeli his *Omphalia*. There is, therefore, no necessity for the application of a new generic name.

Char. *Glau. testa conica seu turrita, crassa; anfractibus numerosis, liris spiralibus, levibus aut granulatis, plerumque ornatis; basi ultimi anfractus convexa; apertura ovata, antice truncata seu subemarginata; labro postice aut prope medium insinuato; labio calloso, columellam crassam, plus minusve excavatam, formante.*

Many details concerning the distinguishing characters of this genus have been reported in my revision of the Gosau-Gastropoda, p. 11 (Sitzb. Akad., Wien, 1865, Vol. LII). In the same paper I have also referred to the great similarities, which exist between the shells of *Glauconia* and the well known *Turritella cathedralis*, Brong. This last named species has been repeatedly determined as a *Proto*, though it is very difficult to understand what the real signification of that genus is.

The name *Proto* was given by Defrance (Dict. des sc. nat. etc., 1826, Vol. XLIII, p. 410, Zool. pl. Turriculées foss., fig. 1) to a small, supposed fossil shell, consisting of about 12 nearly smooth whorls, and in form very much resembling a young *Turritella*. The margins of the aperture are entire and somewhat expanded. This form of the aperture recalls evidently that of *Chilocyclus*, Bronn, (*Cochlearia*, Brown apud Münster, olim.), in which this expansion of the margins exists only in somewhat

a higher degree. With the exception of some species of *Loxonema* (sub-family CHEMNITZIINÆ of EULIMIDÆ), I do not know a single shell, which would agree in all its characteristics with the original *Proto Maraschini* of Defrance; and should it be really different from the last named genus, (for it is perfectly impossible to decide this either from the existing figure or description), it must receive a new generic denomination, as that of *Proto* had been already, before Defrance, applied by several authors in a different sense. This genus must then be placed in the CHEMNITZIINÆ, or, if its relations to *Chilocyclus* can be better established, in the SCALIDÆ.

Blainville, following Defrance's later researches on his *Proto*, placed the *Turr. cathedralis* in the same genus, and as this species was well known to many conchologists, the consequence has been, that the characters of *Proto* have been defined from this second and not from the original species, for which the name was at first proposed. Hence all the subsequent controversies between different authors.

The shell of *Turr. cathedralis* is remarkably strong and solid, as compared with most other *Turritellæ;* the outer lip is thin, with a broad insinuation in the middle, and a second narrower but deeper insinuation is found anteriorly, producing on the basis of the last whorl the formation of an elevated ridge, which consists of thin, single lamellæ according to the progressive growth of the shell. In some specimens at least, as seen, for instance, in Sowerby's figure, in the Quart. Journ. Geol. Soc., Lond., III, pl. 20, fig. 26, the anterior portion of the aperture was distinctly produced into a kind of short canal, which is very rarely developed to that extent in the cretaceous species of *Glauconia.* In these the anterior channel is moreover replaced by a simple insinuation, but in every other respect they are quite similarly formed.

Comparing thus the *Turr. cathedralis* with the genus *Glauconia*, it is really difficult to point out any characteristic distinctions, save perhaps the great length of the spire of the former. I may add that the species does not, at least in the Vienna basin, occur in truly marine beds, but rather in brackish deposits associated with POTAMIDINÆ, such as *Cerith. margaritaceum, C. plicatum* and others. It is therefore very probable, that *T. cathedralis* ought to be regarded as the tertiary representative of the cretaceous *Glauconia.*

Pictet and Campiche (Pal. Suisse, 3me. Ser., p. 311, etc.,) reserve the species of *Glauconia* under the name of *Turritella*, and propose three sections in that genus, two for the genus *Glauconia*, and one in which they place all the species commonly known as *Turritella.* For the two first they take as a ground of distinction the presence or absence of an umbilicus. We do not in the least intend to deny the importance of those characters in many cases, but we cannot help doubting their value in the present one. For we have repeatedly observed, (*vide* Sitzb. Akad., Wien, Revision der Gosau-Gastropoden, pp. 11-15), that the columella is in one and the same species sometimes solid, and at other times hollowed out. It is by no means rare to find young shells provided with a large open umbilicus, while fully grown ones have no trace of it. Such is really very often the case with *Glauconia*, and full grown shells have, in consequence of the great thickness of the inner lip, the columella apparently quite solid. For these and other considerable

changes in the form and ornamentation of the shell we can only account by the supposition, that the individuals were living in brackish–, or partially even in fresh-waters. Save in the *POTAMIDINÆ* or the *MELANIIDÆ* such remarkable variations in one and the same species are scarcely to be found in any other group. Thus the mode of life can render a character, which is sometimes very important in a classificatory point of view, under other circumstances almost valueless in that respect. We gladly concede, that the general form of the shells and especially that of the whorls with their spirally arranged ornamentations appears fully to justify the classification of *Glauconia* in the family *TURRITELLIDÆ*, but at the same time the massive structure of these conical shells and the anterior insinuation, or emargination of the aperture, are so far characteristic, as to make a generic separation of those shells very desirable.

I have already in my revision of the Gosau-Gastropoda advocated the idea, that most of the species of *Glauconia* appear to be inhabitants of brackish– or fresh-water. I may also refer to the similarity in the structure of the shells and the form of the aperture between *Glauconia* and *Lampania* or *Ceriphasia* of the *MELANIIDÆ*. In this respect our genus may be regarded as a truly intermediate form between this last named family and the *TURRITELLIDÆ*, for it may almost with the same reason be supposed to belong to the former.

The oldest known representative of *Glauconia* is described by Dunker from the Wealden deposits of Northern Germany under the name of *Melania*,– having been previously reported as *Melanopsis* or *Potamides*,– namely, *Melania strombiformis*, Schlot. sp. (Wealden Monograph, p. 50, pl. 10, figs. 17-19 and 24). Of the other species noted in the same work the generic determination is somewhat doubtful; some of them may belong to *Glauconia*, others to *Canthidomus* (from which *Lyrcea* is scarcely different), or *Faunus*, and a few appear to be true *Melaniæ*.

In the cretaceous deposits three different horizons of *Glauconia* are at present known. The first are those described by Coquand in his Monog. of the 'Etage Aptien' (Marseille, 1866), namely, *Glau. Pizcuetana* (*Pleurotomaria?* id., Vilanova, Mem. R. Acad., Madrid, 1859, Vol. IV., pl. 2, fig. 12,—*Cassiope. id.* et *Tekelii*, Coquand, loc. cit., p. 58, pl. 3, figs. 1-3), a species much resembling the senonien *Glau. Renauxiana*, D'Orb.; *Glau. (Cassiope) turrita*, Coq. (l. cit., p. 60, pl. 3, figs. 5-6), which is probably not specifically different from *Glau. helvetica*, Pictet et Renevier; *Glau. Lujani*, (*Cerith. id.* Verneuil,– *Cerith. Lusani* apud Vilanova,– *Cerith. Heeri*, Pictet et Renev.,– *Cassiope Verneuili* et *Lujani*, Coquand, l. cit., pl. 4, figs. 1—5), is closely allied to the last species; and *Glau. (Cassiope) Renevieri*, Coquand (ibid., fig. 8), which is very likely not different from *Glau. Pizcuetana*.

The second horizon of *Glauconia* is in the Cenomanien. Prof. Hebert, whose instructive collections in Paris I had lately an opportunity of examining, showed me a fine series of three or four new species from these beds, but the names and descriptions of these species are not yet published.

At last come the species from the Gosau and a few from Northern Germany. They have been enumerated by Pictet et Campiche (Mat. Pal. Suisse, 3me. Ser., pp. 324-325, under sect. 2 and 3 of *Turritella*) and in part critically examined by myself (Revision der Gosau-Gastropoden, p. 15, etc., in Sitzb. Akad., Wien, 1865, Vol. LII). I may add, that I have since examined the originals of D'Orbigny's *Turritella Bauga*, and believe it to be a true *Turritella*, not a *Glauconia* as stated in my paper. I have also examined the specimens of D'Orbigny's *Turr. provincialis* (Prod. II, p. 217,) and found them to be identical with the *Glauconia conoidea*, Sow. sp. from the Gosau deposits of the North-eastern Alps.

In our South Indian cretaceous deposits only fragments have as yet occurred, which could doubtfully be referred to *Glauconia*.

2.—*Arcotia*, Stoliczka, 1868.

Arc. testa turrita, elongata, crassiuscula; anfractibus spiraliter striatis; striis incrementi rectis, non sinuatis; columella excavata; apertura angulate-rotundata, antice sub-effusa.

The species, described under the name of *Arcotia indica*, Stol. (p. 215) is considered as the type of the genus. The difference from *Turritella* (as restricted) consists in the want of any insinuations on the striæ of growth, and in the presence of a hollow columella.

The only other fossil species, which we were able to trace as belonging to this genus, is the *Turrit. Roissyi*, d'Arch. from the oolitic – (with *Terebratula decorata*, Schloth.),—beds near Eparcy, in the dept. of Aisne in France, (Mem. Soc. Géol., France, 1842, Vol. V, p. 380, pl. 30, fig. 2). The genus recalls, moreover, some palæozoic species, which are often referred to the *Trochidæ*, like *Trochus Yvanii* Léveille, (Mem. Soc. Géol., France, 1835, II, p. 39, pl. 2, fig. 24) and oth.

Dunker describes (Journ. de Conchiliologie, 1862, Vol. X, p. 354, pl. 13, fig. 8), a recent *Turr. umbilicata* [non *idem* Coquand, 1859]; but the specimen, which he figures, is evidently a very young shell, and the striæ of growth are not marked, for which reason it is difficult to say whether it belongs to *Arcotia*.

3.—*Mesalia*, Gray, 1842, a form of *Turritella*, which is characterised by having the last whorl much larger than the others, the aperture more produced anteriorly, and the columella somewhat twisted at its termination. It strongly recalls the form of *Sandbergeria* in the *Cerithiidæ*. There are several very characteristic species known from tertiary deposits, and Deshayes (Paris foss., Vol. II, p. 322, etc.,) accepts *Mesalia* as a division of *Turritella*, proper. Cretaceous species are as yet scarcely known. The *Chem. clathrata*, Binkh. (Monog. Gast. et Ceph. Limbg., 1861, pt. I, p. 22, pl. 5, fig. 4) is probably a *Mesalia*.

4.—The name *Lithotrochus* has been proposed by Conrad for the *Turritella Humboldtii*, Buch., sp. (non *idem*, J. Müller, 1851,—*T. Andii*, d'Orb., Mem. Soc. Géol., France, 1851, IV, p. 12, pl. 2, figs. 7-8). This is no doubt a remarkable form, differing considerably from all true *Turritellæ*, and approaching somewhat to *Mesalia*, but it has not the produced basis of the last whorl of that genus, unless

all the specimens which have been figured were very imperfect, which does not appear very likely. The thickened sutural band provided with very numerous striæ of growth may add to the peculiarities, which entitle the species to a generic distinction, for it must have been in some way connected with a different form of the margin of the aperture. Bayle and Coquand (loc. cit.) state, that they received the species *Lith. Humboldtii* with *Terr. tetraedra* in one and the same piece of rock, and besides in company with *Gryphæa cymbium* and other characteristically liassic species. The species must, therefore, be struck out of the list of cretaceous fossils, where it had been placed by D'Orbigny.

5.—*Turritella*, Lamarck, 1799 (H. and A. Adams' Genera I, p. 351, including *Torcula* and *Zaria* of Gray as sub-genera). Under *Turritella* (as restricted) those species are here retained, which have a number of equal, chiefly thin, spiral striæ, and the volutions flattened or slightly convex. Those species are called *Torcula*, the whorls of which are more or less excavated in the middle, and have two spiral keels near the sutures, while in *Zaria* the whorls are provided with a number of sharp keels, which are specially strong below the middle of the whorls. Each of the divisions exhibits certain minor distinctions, but the form of the shell is never markedly different, the whorls increasing very gradually in size. In determining a large number of fossil species, which are not always well preserved, it is almost impossible to fix the limit between *Torcula* and *Turritella*, and equally so between this latter and *Zaria*. The outer lip is always insinuated, only in different degrees in various species, the inner lip is evenly arcuated, and the axis of the shell, though always solid, still very thin.

The determination of the cretaceous species, with respect to the sub-generic divisions of *Turritella*, is as yet very unsatisfactorily known. So many of them are based often upon one or two additional spiral striæ of a few whorls, and without any reference to the proportions of the same, that we are probably not beyond the truth, when we say that of the 76 European species of *Turritella*, quoted by Pictet and Campiche, one-third will have to be abandoned. With regard to the critical examination of a number of the Alpine species, I must refer to my revision of the Gosau-Gastropoda in Sitz. Akad., Wien, 1865, LII, p. 8, etc., and also in 'Jahrbuch Geol. Reichs-Anst.' Wien, 1863, XIII, pp. 53-54.

In addition to those already mentioned in the Paléont. Suisse, 3me. Ser., pp. 318-324, we quote at present the following: *Turr. plana*, *T. ? sinistra*, *T. conferta*, *T. Falcoburgensis*, *T. ciphyana* (vide Binkhorst, Monog. Gast. et Ceph. craie de Limbourg, 1861, pt. 1, pp. 33-34 and 77) from the upper cretaceous beds near Maestricht. The state of preservation of many of the species is far from satisfactory. *Turr. Sarthensis*, *T. gracilis*, *T. alternata* and *T. acicula* are mentioned as new by Gueranger from the 'Grés verts' of the dept. de la Sarthe (Ess. d'une Repertoire Paléont., etc., Mans, 1853, p. 29). Of the three first-named species the same author gives figures in his 'Album Paléont. etc.', 1867, pl. 9, but I should really be at a loss, how to recognise those species again from such small fragments! *Turr. inique-ornata*, Drescher (Zeitsch. deutsch. Geol. Gesellsch., 1863, Vol. XV, p. 333, pl. 9, fig. 1), a species very much like the *Turr. rigida*, Sow. from the

Gosau deposits. *Turr. venusta*, *T. Tournali*, *T. Vidalina*, *T. pusilla* and *T. Fresqueti*, Coquand, from Spain (Monog. Paléont. de l'étage Aptien, etc., Marseille, 1866, pp. 55-57).

To the two species already known from Africa (Materiaux, etc., p. 326,) *Turr.* [*? Mathilda*] *Bonei* [not *Bouei*, loc. cit.] and *T. Meadii*, Baily, [not Sharpe, loc. cit.], have to be added the following, described in the Géol. et Paléont. prov. Constantine par H. Coquand, (Marseille, 1862): *T. gigantea*, p. 175, *T. pustulifera*, *T. nerinæformis*, *T. leoperdites*, *T. Tenouklensis*, (p. 176), *T. carentonensis*, and *T. Bucheroni*, (p. 329). How many of these are true *Turritellæ* is not easy to imagine, for most of them are based upon very imperfect casts only.

To the American species, quoted by Pictet and Campiche (loc. cit., p. 326) have to be added several noticed by Gabb in his Catalogue, (Proceed. Am. Phil. Soc., 1861, VIII, p. 147) *T. multilineata*, Ev. and Shum., 1857 (not *idem*, Müller, 1851, and not *multilineata*, Gabb), *T. pumila*, *T. Saffordii*, *T. Tennesseensis* and *T. Hardemanensis* of Gabb, *T. trilira*, Conrad; all the species are described in the 4th Vol., pp. 285 and 392 of the Journ. of the Acad. Nat. Sc. Philadelphia; farther *T. infralineata*, *T. Veatchii*, *T. Chicoensis*, *T. robusta*, Gabb, *T. Uvasana*, Conrad; (*vide* Pal. Calif., 1864, Vol. I, pp. 131, etc.), and *T. infra-granulata*, Gabb (ibid. p. 212); also *T. corsicana* and *Winchelli*, Shumard, from Texas.

The South Indian cretaceous species have increased from five, as known through Forbes' and d'Orbigny's investigations, to thirteen, twelve of which will be found described on the subsequent pages under *Turritella*, the sub-generic names being noted in a parenthesis. They are the following: *Arcotia indica*, Stol.; *Turritella asperata*, Stol.; *T. Pondicherriensis*, Forb.; *T. gemina*, Stol.; *T. dispassa*, Stol.; *T. affinis*, Müller; *T. Neptuni*, Münst.; *T. elicita*, Stol.; *T. contumescens*, Stol.; *T. nerinea*, Roem.; *T. nodosa*, Roem.; *T. multistriata*, Reuss.; *T. ventricosa*, Forb.; *T. Breantiana*, d'Orbigny. In reality only eight new species have been added to the number already known; the rest have been found to be identical with species formerly described from Europe or elsewhere.

6.—*Mathilda*, Semper, 1865, (Journ. de Conchyl., Paris, Vol. V, p. 330, etc.,) has been proposed for a number of small, spirally ribbed *Turritellæ* with a simple or anteriorly sub-effuse aperture and a mammillate apex, consisting of one, or one and a half, strongly inflated smooth whorls. Mr. Semper concludes from this, that the respective species belong to the family *Pyramidellidæ*. We have already expressed our views as regards the limits of this family (vide p. 171), and shall offer some farther remarks subsequently on the same subject, when speaking of the *Eulimidæ*. We can only mention here that there are several species of true *Pyramidella* and *Obeliscus*, which have not a mammillate apex, and, on the other hand, several species of *Cerithiidæ*, *Scalidæ*, and even of the *Buccinidæ*, which have it distinctly mammillate. The *chemnitziinæ* (of the fam. *Eulimidæ*) have usually an inflated apex, but this is not an exclusive character, just as it is not in the *Volutidæ*. There are several jurassic* species, which have most probably to be referred to

* Dr. Laube describes a *Mathilda euglypha* from the oolitic beds of Balin; vide Sitz. Akad., Wien, 1866, LIV.

Mathilda,* although we could not pronounce a definite opinion as to whether the genus will stand as proposed by Mr. Semper. The *Turritella Bonei*, Baily, (Quart. Journ. Geol. Soc., Lond., XI, p. 455, pl. 12, fig. 7, not *T. Bouei* apud Pictet et Campiche) from South Africa could possibly be a *Mathilda*, but it would be a gigantic species of this genus. Several tertiary and recent species were described by Semper. The cancellated species of *Mathilda* would form a passage to the next family, the *Scalidæ*.

XLVII.—ARCOTIA, *Stoliczka*, 1868.

1. Arcotia indica, *Stoliczka*. Pl. XVI, Fig. 12, and Pl. XIX, Fig. 6.

Arc. testa turrita, crassa; anfractibus antice bicarinatis, (carina anteriori multo tenuiori, postica acute elevata), marginem posteriorem versus gradatim angustioribus, striis tribus fortioribus atque multis minoribus ornatis; striis incrementi minutis, rectis; basi ultimi anfractus valde convexa atque spiraliter striata; columella late excavata; apertura intus valide angulata; labio levigato, moderate incrassato.

Spiral angle 35°- 38°; sutural angle 8°- 9°.			
Height of last whorl	: total of shell (consd. as 1·00)	... ...	0·33.
Height of penultimate whorl	: height of spire (consd. as 1·00)	...	0·24.
„ „ „	: its width (consd. as 1·00)	... ...	0·44.

The conical form of the shell, the double keel along the anterior margin, and the gradual posterior tapering of the whorls, as well as the strong convexity of the basis of the last volution, are very distinctive characters of this species. There are generally three thicker spiral lines, of which the one next to the strong keel is thinner than the two others. In younger specimens this third thinner keel is often not very clearly traceable, while in larger specimens a fourth one attains occasionally a nearly equal strength. Besides there is a large number of finer spiral striæ present, all of them crossed by the straight transverse lines of growth. The aperture is rather distinctly angular on the columellar side, and more uniformly roundish on the outer lip. The inner lip is smooth, and like the rest of the shell of considerable thickness.

Coquand describes from Épagnac a *Turr. umbilicata*, (Bull. Soc. Géol. France, 1859, Vol. XVI, p. 979) with narrow and smooth whorls, and a large umbilicus; the short description would rather apply to a *Niso*.

Locality.—North of Alundanapooram, in greyish sandstones; apparently rather rare.

Formation.—Trichinopoly group.

* Conrad (Smithsonian Misc. coll.; Check list inv. foss., eocene, 1866, p. 14,) places the genus in the *Cerithiopsidæ*.

XLVIII.—TURRITELLA, *Lamarck*, 1799.

1. Turritella (Torcula) asperata, *Stoliczka*, Pl. XVII, Fig. 1, and Pl. XIX, Fig. 7.

Turr. testa elongate-conica; anfractibus pluribus, complanatis, liris inæqualibus atque striis spiralibus ornatis: lira posteriori ad marginem suturalem posita subrugosa; lira secunda supra medium sita inæqualiter duplici, acute atque numerose tuberculatu; excavatione mediana anfractuum linea sub-elevata et undulata divisa; liris duabus anterioribus rugosis, inæqualibus, postica crassiore, antica in anfractibus superioribus sæpe obtecta, in ultimo anfractu ad peripheriam carinam basalem formante. Superficies testæ est præterea minutissime spiraliter striata, striis transvertalibus incrementi etiam minutis atque lente insinuatis; basi applanata, striis nonnullis fortioribus atque multis tenuioribus interpositis ornata; apertura angulari; labio moderate crasso, levigato.

Spiral angle 19°; sutural angle 11°.

Height of last whorl	: total of shell (considered as 1·00)	...	0·25.
Height of penultimate whorl	: height of spire (considered as 1·00)	...	0·19.
„ „ „ „	: its width (considered as 1·00) ...	...	0·48.

This very remarkable species has an ornamentation quite different from any known living or fossil *Turritella*. The whorls are in their general aspect flattened, and the entire surface covered with a very fine spiral striation and several strong ridges. Beginning at the posterior or upper margin of the whorls they are placed in the following order: the margin of the suture is formed by a thick rough or obsoletely tuberculated ridge, then follows a double ridge, being unequally divided into a thinner posterior and stronger anterior portion; both are ornamented with numerous sharply pointed tubercles. Next follows a broad excavation of the whorls, having an undulating keel in the middle; and there are two other rough ridges, the one bounding the excavation being stronger, the other next to the lower suture thinner; the latter of these two is often partially covered by the succeeding whorl, while on the last whorl it forms the keel of the periphery. In young specimens the inequality of the ridges is not so apparent, all of them being of more uniform thickness. The spiral striation is very distinct, and the striæ themselves are of different strength, and slightly undulating, or occasionally interrupted in their course. The striæ of growth show a distinct sinuation, which is strongest on the tuberculated ridge, above the middle of the whorls. The aperture is angular; the inner lip has a moderate thickness; the margin of the outer lip has not been observed perfect, but judging from the curve of the striæ of growth, it must have been broadly insinuated above the middle of the height of the whorls; columella thin and solid.

The only species, which appears to have a similar character of ornamentation, is one from the upper cretaceous deposits of Aachen, described and figured by J. Müller as *Turr. nodosa*, Römer (Mon. Pet. Aach. Kreidef. II, 1851, p. 32, pl. 4, fig. 18). It differs principally from our species by a much greater height of the whorls, but I do not think that it has been correctly identified with the species of Römer. I shall mention the difference again, when speaking of the *Turr. nodosa*.

Locality.—Near Ninnyoor, in white calcareous sandstone; apparently very rare.

Formation.—Arrialoor group.

2. TURRITELLA (TORCULA) PONDICHERRIENSIS, *Forbes*, Pl. XVI, Figs. 18, 19; Pl. XIX, Fig. 8.

1846. *Turritella pondicherriensis*, Forbes, Trans. Geol. Soc., Lond., Vol. VII, p. 123, Pl. XIII, Fig. 4.
1847. „ *angulata*, D'Orb. Voy. Astrolabe, Atl. Paléont., Pl. III, Fig. 27, (non *id.* Sowerby, D'Orbigny, 1842, and others).
1850. „ *Pondicherriensis*, in D'Orbigny's Prod. II, p. 218, including *Turr. angulosa*, D'Orb.=*T. angulata* in the Voy. of the Astrolabe.

Turr. testa elongate-conica, crassa; anfractibus ad margines tumescentibus, suturis profundis sejunctis, ad medium paulo excavatis atque 5-6*—liratis, liris simplicibus, tenuibus, semper sulca mediana divisis; superficie striis minutis spiralibus atque transversalibus decussantibus ornatis, ultimis paulo insinuatis; basi ad peripheriam subcarinata, applanata, spiraliter striata; apertura rotundate angulata.*

Spiral angle 25°-30°; sutural angle 5°-6°.
Approximate height of last whorl : total of shell (considered as 1·00) ... ... 0·20.
„ „ of penultimate whorl : height of spire (considered as 1·00) 0·16.
„ „ „ „ : its width (considered as 1·00) ... 0·49.

The posterior margin of each of the whorls is always strongly thickened, forming a broad slightly rounded ridge; the anterior marginal thickening always forms a smaller and narrower ridge; occasionally it is nearly obsolete. The middle portion of the whorls is excavated, and in regularly grown specimens ornamented with six spiral ridges, being divided in the middle by a somewhat broader furrow into sets of three each. The most anterior or lowest ridge is always the strongest and sometimes the next above it is united with it, giving it a still greater thickness; in such cases only five spiral keels are present. On the other hand, in cases where the anterior sutural ridge is very narrow, there appear to be seven instead of six keels present. Young specimens have generally only the posterior marginal ridge quite distinct.

The entire surface of the shell is besides covered with fine spiral striæ, which are very much interrupted, rough and undulated by the striæ of growth. The latter are distinctly insinuated somewhat above the middle of the height of each whorl, and equally undulating in their course. The aperture is roundish angular; the shell is remarkably thick, the section of the whorls internally nearly circular.

Localities.—Near Pondicherry, in bluish, calcareous sandstone, and near Arrialoor, in whitish soft sandstone.

Formation.—Arrialoor group. I think the extent of the Valudayoor group, as being the lowest and about equivalent to the Ootatoor beds, must be accepted very cautiously. The larger number of fossils from these Pondicherry beds are rather identical with those from the Arrialoor group.

3. Turritella (Torcula) gemina, *Stoliczka*, Pl. XVI, Figs. 10, 11; Pl. XIX, Fig. 9.

Turr. testa elongate-conica; anfractibus planulatis, suturis profundis sejunctis, postice paulo tumescentibus, et ad medium lente excavatis, spiraliter 7-8*-striatis, antice prope suturam bicarinatis; striis transversalibus incrementi minutissimis, insinuatis; basi plana, spiraliter striis fortioribus atque tenuioribus ornata; apertura angulari, labio antice paulo-incrassato, labro tenuissimo.*

Spiral angle 30°; sutural angle 3°-4°.	
Height of last whorl : total of shell (considered as 1·00) ...	... 0·25.
Height of penultimate whorl : height of spire (consd. as 1·00) ...	... 0·18.
„ „ „ : its width (consd. as 1·00) ...	... 0·49.

The two keels on the anterior or lower margin of each whorl are very characteristic of this species; they seem to be always present, the marginal one being somewhat thinner than the one above. The rest of the surface of the whorls is covered with seven or eight spiral striæ, either all of nearly equal strength, or one or two in the middle stronger than the others. The middle portion of the whorls is in young specimens perfectly flat, in older ones a little concave; the posterior portion is also in larger grown specimens somewhat thickened, sloping gradually towards the suture. The striæ of growth are very fine, insinuated about the middle, producing often a slight undulation on the spiral striæ.

Localities.—Near Arrialoor and Karapaudy, in whitish siliceous sandstone; very rare.

Formation.—Arrialoor group.

4. Turritella (Torcula) dispassa, *Stoliczka*, Pl. XVI, Figs. 13, 14; and Pl. XIX, Figs. 10, 11.

Turr. testa elongata; anfractibus numerosis, angustis, ad suturas valde contractis, prope marginem anteriorem acute carinatis, primis fere planis, posterioribus ad medium lente excavatis atque supra excavationem paulo tumescentibus, spiraliter striatis: striis numerosissimis, tribus seu quatuor fortioribus; lineis incrementi insinuatis; basi ultimi anfractus aliquando producta, convexa, spiraliter striata, ad peripheriam carinata; apertura angulari, altiore quam lata.

Spiral angle 20°-22°; sutural angle 8°-9°.	
Approximate height of last whorl : total of shell (considered as 1·00) ...	0·22.
„ „ of penultimate whorl : height of spire (consd. as 1·00)	0·17.
„ „ „ „ : its width (consd. as 1·00) ...	0·58.

The single sharp keel along the anterior margin of each of the whorls, which are very high in proportion to their width, the slender form, and the strongly produced basis of the last volution distinguish this species readily from *T. gemina*, n. sp., or *T. Pondicherriensis*, Forb.

Very young specimens have the whorls quite flat, anteriorly always keeled and gradually tapering towards the posterior suture. In older and more grown specimens (Pl. XVI, Fig. 14) the whorls become somewhat concave about the middle, but they are on both the sutures much contracted. Among the numerous fine spiral striæ there are generally three or four, which increase in strength with the age and size of the specimen.

Locality.—Near Arrialoor, in whitish sandstone.

Formation.—Arrialoor group.

5. Turritella (Torcula) affinis, *Müller*, Pl. XVII, Figs. 17-18; Pl. XIX, Figs. 12-13.

1851. *Turritella affinis*, Müller (Pet. Aach. Kreide. II, p. 31, Pl. IV, Fig. 11).

Turr. testa conica, anfractibus ad margines crasse sed obtuse carinatis, ad medium excavatis, in superficie numerose striatis: striis incrementi minutissimis, insinuatis; basi ultimi anfractus subconvexa, paululum prominente; apertura rotundate quadrangulari, ad marginem exteriorem emarginata.

Spiral angle 22°; sutural angle 7°- 8°.	
Height of last whorl : total of shell (considered as 1·00)	0·30.
Height of penultimate whorl : height of spire (consd. as 1·00)	0·25.
„ „ „ : its width (consd. as 1·00)	0·51.

Each of the whorls is ornamented with three keels, of which the middle one is the thinnest, and placed somewhat below the centre. The anterior keel is generally sharper and often stronger, while the posterior slopes gradually towards the suture. The entire surface of the shell is ornamented with fine spiral striæ of different strength, but according to the state of preservation and other causes the appearance of the shell is very much changed. Sometimes the surface of the shell seems to be almost smooth; in other specimens there are only a few striæ traceable above and below each keel, varying in strength among themselves; again, in others there are tolerably strong striæ present, one bounding each of the two stronger keels above and below, and there are besides one or two similar striæ along the posterior and one along the anterior suture.

In young specimens the fine striation almost disappears, and the difference in the strength of the upper and lower and the median keels is not so apparent. The striæ of growth produce on the finer spiral ornamentation often a slight granulation.

As I have already observed, our specimens agree in every respect with the figure and description of the species from the cretaceous deposits of Aachen, but there are a number of other species known, which are very closely related, and several of them perhaps identical with the above named species. I would specially mention *T. Omalusi*, Müller, (ibid. fig. 12); *T. nitidula*, Binkhorst (Monog. Gast. et Ceph. Maestricht, p. 32, pl. 5ª, fig. 12), and *T. Eichwaldiana*, Goldf. (Pet. Germ. III, pl. 197, fig. 4). The figure of this last species, given by Zekeli in the

Abhandl. Geol. Reichs-Anst. I, pt. II, p. 22, pl. 1, fig. 2, must have been taken from a somewhat unusually rare variety; for I have generally found, that there is only one middle keel present, very like that in the *T. affinis*, not two keels. I am very much disposed to believe, that at least the *T. nitidula* and *Eichwaldiana* are identical with the last mentioned species, for the increase of the whorls is in all exactly the same; but I have not at present the materials to confirm this supposition.

Localities.—Near Coonum and Veraghoor; at the first in light coloured and bluish sandstones, and social in large numbers at the second locality.

Formation.—Trichinopoly group.

6. Turritella Neptuni, *Münster*, Pl. XVI, Fig. 16, and Pl. XIX, Fig. 14.

1844. *Turritella Neptuni*, Münster in Gold. Petref. Germ. III, p. 106, Pl. CXCVI, Fig. 15.
1846? ——— *Neptuni*, apud d'Archiac, Mem. Soc. Géol. France, Ser. II, Vol. II, p. 344, Pl. XXV, Figs. 2b and 2d, non Figs. 2 and 2c.

Turr. testa elongata, anfractibus complanatis, ad suturam posteriorem paulo tumescentibus, spiraliter numerosissime striatis, striis nonnullis (3-4) fortioribus, ceteris tenuissimis.

Spiral angle 20°; sutural angle 10°.
Height of a whorl : its width (considered as 1·00) ... ... 0·58.

The surface of the whorls is covered with numerous fine spiral striæ, of which three or four on the anterior portion are often somewhat stronger than the rest. Each of the whorls covers with its posterior margin a small portion of the preceding one, and on account of this higher extension a narrow elevated band is formed, causing naturally a depression below it. This peculiar form of the whorls is by Münster called "übergreifend." The ornamentation of our specimen is perfectly identical with that of Goldfuss' figure, so that there can be very little doubt left of its being the same species.

Münster's original specimens were from the middle cretaceous strata of Tournay in Belgium. D'Archiac described subsequently the fossils of this locality in more detail, and had apparently two different forms under examination, which he referred to Münster's species. As he, however, himself admits (vide Mem. Soc. Géol. France, Ser. II, Vol. II, p. 344), the specimens in figures 2b and 2d may be different from those represented in 2 and 2c. The former with their tumescent and 'overreaching' posterior margin and interiorly roundish section of the whorls appear to belong properly to Münster's *T. Neptuni*, while to the other two figures d'Archiac's first name *T. subvibrayeana*, (Bull. Soc. Géol. France, t. III, 1846, p. 337)=*T. Archiaci*, d'Orb. (Prod. II, p. 148) ought to be applied. Such a distinction appears to be at least the most probable and natural, although conclusions drawn from single figures, and not referring to perfect specimens, can never be accepted without a little hesitation.

Locality.—Near Alundanapooram, in whitish sandstone; very rare.

Formation.—Trichinopoly group.

7. Turritella elicita, *Stoliczka*, Pl. XIV, Fig. 3, and Pl. XIX, Figs. 15-16.

Turr. testa perlonga, valde attenuata; anfractibus numerosis, postice late tumescentibus, ad medium paulo excavatis, superioribus spiraliter minute striatis atque liratis, inferioribus levigatis; striis incrementi minutis, supra medium valde insinuatis; ultimo anfractu ad peripheriam basalem subcarinato; basi paululum producta; apertura subquadrangulari, altiore quam lata.

Spiral angle 9°; sutural angle 12°-13°.
Height of one whorl : its width (considered as 1·00) ... ... 0·70.

The very elongated form and the broad swelling along the posterior suture give this species at first sight the appearance of a *Nerinea;* the sutural swelling is, however, not margined by a separate line, as is the case in all *Nerineæ,* and the want of all columellar plaits confirms that distinction.

A very characteristic mark of this species is produced by the great height of the whorls in proportion to their width, which distinction separates it readily from *T. biformis,* Goldf. (Petr. Germ. III, pl. 197, fig. 8), and also from the intertrappean *T. prælonga,* Hislop, with which Mr. H. Blanford thought it apparently identical (*vide* Mem. Geol. Sur. India, IV, p. 141). The uppermost whorls are minutely spirally striated on the elevated band, and more strongly on the rest of the surface, but on the larger whorls only the insinuated striæ of growth are distinctly traceable (*vide* Pl. XIX, Fig. 16). The basis of the last whorl is slightly convex, obtusely carinated at the periphery and apparently smooth.

Locality.—In the white sandy limestones near Ninnyoor, where the species was found with *Nerinea Blanfordiana,* and several *Cypræidæ* and *Volutidæ.*

Formation.—Arrialoor group.

8. Turritella contumescens, *Stoliczka*, Pl. XVI, Fig. 17; Pl. XIX, Fig. 17.

Turr. testa anfractibus numerosis, complanatis composita; margine posteriori anfractuum tumescente, tuberculis transversaliter elongatis atque obliquis ornato; superficie anfractuum infrá quatuor striis granulosis fortioribus atque nonnullis minutissimis notata.

Spiral angle 20°; sutural angle 10°.
Height of one whorl : its width (consd. as 1·00) ... ... 0·40.

The ornamentation of this species recalls very much some other similar cretaceous forms, like *T. Decheniana,* Goldf. (Pet. Germ. pt. III, p. 107, pl. 197, fig. 3), or *T. biformis,* Sow. (ibid. fig. 8; Stoliczka in Sitzgb. Akad., Wien, LII, Revision, etc., p. 8), but the great width of the whorls in proportion to their height is a very marked distinction of the Indian fossil.

The posterior margin of each whorl is ornamented with a broad, tuberculated band or ridge, and below it are four spiral granulated striæ alternating with some other much finer ones. The granulation of these striæ, specially of that on the anterior suture, is not always very distinctly traceable, although it never appears to be wanting. The basis of each whorl is rather flattened and spirally striated; the section of the whorls is roundly angular.

Locality.—Near Comarapolliam and East of Arrialoor, in whitish siliceous sandstones; rare.

Formation.—Arrialoor group.

9. Turritella? nerinea, *Römer*, Pl. XVI, Fig. 15; and Pl. XIX, Figs. 18-19.

1841. *Turritella nerinea*, Römer, Norddeutsche Kreide., p. 80, Pl. XI, Fig. 21.
1844. „ *Decheniana*, Goldf. Petr. Germ., pt. III, p. 107, Pl. CXCVII, Fig. 3.
1850. „ *nerinea*, in Geinitz' Quadersandst., p. 124.

It is not without doubt that we refer an imperfect specimen of a *Turritella* to this species, which is so common in the upper cretaceous beds of Northern Germany. The character of the ornamentation is in general the same, as noted by Goldfuss and Römer. There are six spiral and granulated striæ on each whorl, the one on the posterior or upper margin being the strongest, and the two anterior being placed closer to each other, than the one immediately below the strong keel. The other striæ are placed still nearer to the anterior suture of the whorls and are usually not granulated. The entire surface of the shell is besides very minutely striated.

The differences, which we have to note between our fossil and the European species, are the whorls being slightly higher in proportion to their width, and the fourth of the striæ from the top being stronger, than any of the two others on each side, above and below it. In Goldfuss' figure a similar fact seems to be indicated in the third ridge from above, and it is not quite impossible that such a slight variation may occur in the ornamentation of one and the same species. We do not wish to be positive as to our identification of such imperfect specimens, but we desire to draw the attention of any subsequent explorer in South India to this very interesting fossil, for if it proves to be identical, it is more important than a dozen of other new species.

Our species can also be compared with Sowerby's *T. granulata* from Blackdown, but in this the spiral keels are usually more closely arranged.

Locality.—W. of Odium, in a calcareous sandstone; apparently very rare.

Formation.—Ootatoor group.

10. Turritella nodosa, *Römer*. Pl. XVII, Fig. 7, and Pl. XIX, Figs. 20-21.

1841. *Turritella nodosa*, Römer (Nordd. Kreide., p. 80, Pl. XI, Fig. 20).
1844. „ *quinquecincta*, Goldf. (Petr. Germ. III, p. 106, Pl. CXCVII, Fig. 17).

Turr. testa perlonga; anfractibus numerosis, complanatis, spiraliter minutissime striatis atque quinque liris crassioribus ornatis: prima ad marginem anteriorem posita tenuissima, sublevigata, ceteris fortioribus granulosis; striis incrementi minutis, insinuatis; basi convexa, producta, spiraliter striata, ad peripheriam carinata, apertura rotundate ovata, marginibus attenuatis instructa.

Spiral angle 12°-15°; sutural angle 10°-12°.
Height of last whorl : total of shell (considered as 1·00) ... ... 0·16.
Height of penultimate whorl : height of spire (considered as 1·00) ... 0·12.
„ „ „ : its width (considered as 1·00) ... ... 0·69.

In connection with the elongated form and considerable height of the whorls, in proportion to their width, the principal distinctive characters lie in the ornamentation. Each whorl has five spiral ridges, the uppermost or posterior of which begins at the suture and the others follow at nearly equal distances from each other. The anterior ridge is the thinnest and is nearly all through equal in strength. The four above the first are distinctly, although not strongly, granulated, and of these sometimes the lowest is thicker than the others, sometimes the uppermost; not unusually they have all very nearly the same strength. Besides these ridges the entire surface is covered with fine spiral striæ, which again often vary a little in their thickness. The striæ of growth are as usual thin, and strongly insinuated above the middle of the height of the whorls. The basis of the last is produced, convex, carinate on the periphery and spirally striated; the aperture is roundish oval, being somewhat higher than broad.

Locality.—North of Odium; only a few specimens have as yet been found in a greyish calcareous sandstone, belonging to the lowest division of our Trichinopoly cretaceous deposits.

Formation.—Ootatoor group.

There exists a considerable difference between different authors as to what ought to be called *T. nodosa, quinquecincta, multistriata, Noeggerathiana*, a. o. Without pretending to be in a position to clear up all these questions, we must give full reasons for our own identifications, and shew the extent to which they may be accepted.

a. A reference to our figures and those of Goldfuss' of *T. quinquecincta* will be probably found a sufficient proof as to the identity of both fossils. Comparing with this the original drawings of Römer's *T. nodosa* we find, that although identical in form and character of ornamentation, it has the fourth ridge from above the strongest. This variation does occur in one of our specimens (vide Pl. XIX, Fig. 20). Römer speaks only of four spiral ridges, but the existence of the fifth, which is always thinner and placed along the anterior suture, is distinctly traceable on the penultimate whorl of his figure. These two forms can therefore without any great objection be united under the older denomination of *T. nodosa*, as has been done by Geinitz and others. D'Orbigny (Prod. II, 227) considers *T. funiculosa*, Math. (Cat., Méth. etc. pl. 39, fig. 15) as identical with *T. nodosa*. This is, however, scarcely admissible from Matheron's figure, which represents a much more conical and less cylindrical species. Its ornamentation appears to be also much finer. Very probably also belongs to the true *T. nodosa* the form described by Müller (Aach. Kreide., 1851, p. 51) as *T. Noeggerathiana*, so far as can be seen on the original specimens.

b. *T. Noeggerathiana*, Goldf. (Petr. Germ. III, p. 106, pl. 197, fig. 1) is a species with somewhat more convex whorls, each of which is ornamented also with five ridges, of which the anterior one is usually thinner than the rest. The two posterior ones are farther separated from the others, and the anterior of these two—that is the second from above,—is the strongest and most prominent of all.

These differences are very important, they give a totally different character to the ornamentation of the shell and are clearly exhibited in Goldfuss' figures, from which—I must repeat—all my conclusions are drawn. Still, unless the contrary can be proved by Goldfuss' original specimens themselves, I do not think, that there is sufficient reason to identify this species with the *T. nodosa* of Römer.

To *T. Noeggerathiana* most probably is to be referred the species, noted by J. Müller (Aach. Kreid., 1851, p. 32, pl. 4, fig. 18) as *T. nodosa*. The only objection, which could be raised against it, is the want of the thinner anterior ridge, but it may have been only obliterate or not developed, for the space between the ridge above and the suture corresponds with that of Goldfuss' drawing. The *Turr. quinquecincta*, Goldf. var. in Binkhorst's Monog. Gast. et Ceph. Maestricht, 1861, p. 29, pl. 1, fig. 2, is also probably the same.

c. *Turritella multistriata*, Reuss., will be described subsequently.

There is no difficulty in distinguishing any of these three species at the first glance from well preserved specimens, but in cases, in which the upper surface and the keels are much worn off, or when the specimens represent only the top-whorls, it is very difficult, indeed, to be quite certain of the determination.

11.—Turritella (Zaria) multistriata, *Reuss.* Pl. XVII, Figs. 8–14, 16.

1840. *Turritella granulata* (*non* Sow.) and ? *propinqua*, Geinitz, Char. pt. II, pp. 44-45, Pl. XV, Figs. 8-12.
1843. „ *multistriata*, Reuss, Geog. Skizzen, Böhm., pt. II, p. 207.
1844. „ *quadricincta*, *Hagenoviana* and ? *velata*, Goldf. Petr. Germ., pt. III, p. 106, Pl. CXCVI, Figs. 16 and 17*c*.; p. 108, Pl. CXCVII, Figs. 5—6 (non *sexcincta*, Goldf.).
1845. „ *multistriata*, Reuss, Böhm. Kreid., pt. I, p. 51, Pl. X, Fig. 17, and Pl. XI, Fig. 16.
1846. „ „ „ „ pt. II, p. 114.
1846. „ *Sowerbyi*, Forbes, Trans. Geol. Soc., Lond., VII, p. 124, Pl. XV, Fig. 4.
1847. „ *Calypso*, D'Orbigny, Voy. Astrol. Paléont., Atlas, Pl. III, Figs. 28-30.
1850. „ *multistriata*, Reuss, in Geinitz' Quader., p. 124.
1850. „ *Cenomanensis* and ? *Geinitzii*, d'Orbignyi, Prod. II, p. 148.
1851. „ *multistriata*, Rss., Müller, Monog. Aach. Kreid., pt. II, p. 27, Pl. IV, Fig. 1, (excluding *T. quinquecincta*, Goldf. and *Dupiniana*, d'Orb.).
1851. „ *quinquelineata*, *Hagenoviana* and ? *gothica*. Müller, ibid., pp. 28 and 29, Pl. IV, Figs. 3 and 8.
1852. „ *difficilis*, Zekeli, Abhandl. Geol. Reichs.-Anst., Wien, Vol. I, pt. 2, p. 23, Pl. I, Fig. 3 (non *idem* d'Orbigny).
1853. „ *difficilis*, Zek., Reuss. in Sitzungsb. Akad., Wien, Vol. XI, p. 884.
1862. „ *multistriata*, *Hagenoviana*, *quinquelineata*, ? *gothica*, in Pictet's Pal. Suisse, Ser. III, p. 322-323.
1865. „ *Hagenoviana*, Münst., Stoliczka in Sitzb. Akad., Wien, Vol. LII, Revision, etc., p. 9.
1866. „ *quadricincta*, Goldf. Petr. Germ., nov. edit., Pl. C, Figs. 16 and 17*c*, Giebel's Repertorium, p. 107.

Turr. testa elongata, anfractibus sub-convexis, spiraliter 3-5*—liratis, liris tribus anterioribus fortioribus, duabus posterioribus semper tenuioribus, in anfractibus minoribus sæpissime una, nonnunquam utraque, evanescentibus; liris omnibus in adultis levigatis, in junioribus sæpe sub-granulosis, striis minutissimis interpositis alternantibus; basi producta, convexa, spiraliter obsolete striata, ad peripheriam*

carinata ; apertura rotundata, marginibus tenuibus ; labro antice paulo extenso, postice prope medium insinuato.

Spiral angle 15°- 20° ; sutural angle 10°- 12°.
Height of last whorl : total of shell (considered as 1·00) ... ... 0·25.
Height of penultimate whorl : height of spire (consd. as 1·00) ... 0·21.
" " " " : its width (" " ") ... 0·60.

The principal distinguishing characters of this species are the slender elongated form and the numerous slightly convex volutions, which are ornamented with three stronger anterior and two thinner posterior ridges. The first are always present, while of the two others the upper one generally, and sometimes both, disappear on the higher whorls (vide Pl. XVII, Figs. 10, 12, 16). In such cases there is always a broad smooth space left between the suture and the uppermost of the three stronger ridges. The attenuated form and less convex whorls always distinguish such fragments from those of *T. ventricosa*, Forb.

In young specimens the whorls are generally even, the ridges often slightly granulated and occasionally of considerable thickness. In some specimens, which are certainly not otherwise different, the ridges are from the first to the adult stage always smooth, or only partially granulated or interrupted by the lines of growth. Very much depends in such cases on the state of preservation of the shell-surface. I have repeatedly had occasion to observe, that in living *Turritellæ* similar little changes in the ornamentation often take place in the same species at different localities, inhabited by them.

The entire surface of the shell is covered with fine spiral striæ. The basis is convex with an additional keel on the periphery. The aperture is roundish, the margins thin, and in full grown specimens almost dissolute and separated from the rest of the shell along the inner lips ; the outer lip is anteriorly expanded and externally deeply insinuated about the middle.

This species is common all through the upper (Senonien and Turonien) cretaceous deposits of Germany, and occurs also in those of the Alpine Gosau formation.

Localities.—In India we find it represented chiefly in the upper sandy beds of Arrialoor, Karapaudy, Comarapolliam, Mulloor and Vylapaudy ; very rarely it does occur in the calcareous sandstones of the middle series near Garudamungalum.

Formation.—Arrialoor and Trichinopoly groups.

The first notice given of the species seems to be that of Geinitz, when he was induced to identify some of the young granulated specimens with *T. granulata*, Sow. In his later publication (Quader., p. 124) Geinitz refers again some of these specimens to Sowerby's species, but I do not think correctly, with the exception of fig. 7 (loc. cit.), for the whorls of the other figures do not correspond in their proportion with those of *T. granulata*. The description and figure of *T. propinqua*, (loc. cit.) is so insufficient and partly contradictory to the ornamentation of *T. multistriata*, that the identification can be accepted only on Geinitz's own authority. Reuss' name is characteristic and published previously to those of Goldfuss.

The identity of *T. quadricincta and Hagenoviana*, Goldf., cannot be questioned, and I accepted the latter name in my last Revision of the Alpine Gosau-Gastropoda, because I had not before the opportunity of examining several of the doubtful species. In the last edition of the 'Petrefacta Germaniæ' the name *T. qnadriciucta* is retained, but I do not think, that it deserves priority, and it is not characteristic at all. Goldfuss' name of *T. velata* refers to an imperfect cast only. Certainty on these points can be obtained only by the examination of the originals. *T. Sowerbyi* and *T. Calypso* are the same as figured on our Pl. XVII, Figs. 10 and 16. They do not need any farther comment; we examined specimens from the same localities.

To which species D'Orbigny intended to apply his name *T. Geinitzii* is not clear. He refers to a *T. multistriata*, Reuss, but it cannot be that described by Reuss, for in his Prod. II, p. 218, he quotes both the figures of the latter author. Perhaps D'Orbigny meant the *T. granulata* of Geinitz in 'Verst. von Kieslingswalda', 1843, pl. 1, fig. 18; but I really do not see, why this form should be considered different from *T. multistriata* of Reuss.

If according to Dr. J. Müller *T. quinquecincta*, Goldf., and *Dupiniana*, D'Orb., be the same as Reuss' *T. multistriata*, we may quite as well identify with it half a dozen of other cretaceous species. I do not see, however, what difference there exists between the latter species and Müller's *T. quinquelineata*, except perhaps, that the specimens of the last named species were not so well preserved, as those of the former! I would even be very much inclined to suppose, that the *T. gothica* had been founded upon a few of the top-whorls of *T. multistriata*. The Gosau species, which had been identified by Zekeli with *T. difficilis*, D'Orb., has been referred already in my 'Revision &c.,' of 1865 to *T. Hagenoviana*, which is identical with *T. multistriata*.

Lastly, I would draw attention to the *T. Fittoniana*, Münst. (Goldf. Petr. Germ. III., pl. 197, fig. 10, and Zekeli loc. cit., pl. 1, fig. 7). The species has been described from fragments, which were found in the Gosau deposits. I had examined a number of similar fragments, which I first thought to be distinct from *T. multistriata*, but I find now, that they all consist of the uppermost whorls of this latter species. I should not like to pronounce the unquestionable identity of both, without having previously carefully compared Münster's and Zekeli's originals, but I think it very probable, that they are not different. On the other hand, I would retain the *T. sexcincta* of Goldfuss with the *T. difficilis* of D'Orbigny and the *T. multilineata* of Müller as identical with *Turr. sexlineata*, Rœmer. (*vide* my notes on Transylvanian cretaceous fossils in Jahrb. Geol. Reichs-Anst., Wien, 1863*, Vol. XIII, p. 53).

I have also compared in the London Geol. Society's collection the fragments, upon which Mr. Baily based his *Turr. Meadii* † from the cretaceous rocks of Sth. Africa. The ornamentation of this species is very like that of *T. multistriata*, but not sufficiently well preserved to insure correctness of identification.

* These notes were written in November 1861.

† Quart. Journ. Geol. Soc., Lond., 1855, XI, p. 458, pl. 12, fig. 6.

12. Turritella (Zaria) ventricosa, *Forbes*, Pl. XVII, Fig. 15, and Pl. XIX, Figs. 22-23.

1846. *Turr. ventricosa*, Forbes, Trans. Geol. Soc., Lond., Vol. VII, p. 123, Pl. XIII, Fig. 3.

Turr. testa conica, brevi; anfractibus convexis, suturis profundis sejunctis, 3-6*—liratis; liris levigatis, mediis maxime prominentibus, acutis; striis incrementi minutis; basi convexa,* 3-5*—lirata; apertura rotundate ovata.*

Spiral angle 30°- 35°; sutural angle 10°.
Height of last whorl : total of shell (considered as 1·00) ... ... 0·36.
Height of penultimate whorl : height of spire (considered as 1·00) ... 0·27.
„ „ „ : its width („ „ „) ... 0·50.

The short spire, greater convexity of the whorls and a larger spiral angle distinguish this species readily from *T. multistriata.* In young specimens there are often only three spiral ridges, as in the last named species, but they are always much closer to each other and sharper. On the succeeding whorls there are very soon traceable two additional ridges, one along each suture; and towards the last volution a sixth one appears along the anterior margin, while the posterior margin is only somewhat more thickened, without forming a distinct ridge. The last whorl is evenly rounded, and the basis is provided with three to five ridges, the outer one being stronger than those nearer the centre. The striæ of growth obtain, only on the last volution generally, a somewhat greater strength, so as to produce a fine cancellation between the ridges; they are as usual insinuated. The aperture is roundish oval, the outer lip being somewhat produced anteriorly.

Locality.—In the white, sandy limestones at Ninnyoor, where the species does not appear to be rare, occurring with *Turr. elicita*, n. sp. *Nerinea Blanfordiana*, n. sp., and others.

Formation.—Arrialoor group.

13. Turritella (Zaria) Breantiana, *D'Orbigny*, Pl. XVII, Figs. 2-6.

1846. *Turritella monilifera*, Forbes, (*non* Desh.) Trans. Geol. Soc., Lond., VII, p. 123, Pl. XIII, Fig. 2.
1847. „ *Breantiana* et *simplex*, D'Orb., Voy. d'Astrol. Atl. Paléont., Pl. II, Figs. 36-37, and Pl. III, Fig. 26.
1850. „ *Breantiana* et *subsimplex*, D'Orb. Prod. II, p. 218.

Turr. testa elongate conica; anfractibus numerosis, convexis, suturis profundis sejunctis, tribus liris sub-granulosis ornatis: lira mediana ceteris sæpe fortiori, aperturam versus omnibus seu nonnullis evanescentibus; striis incrementi minutissimis, valde insinuatis; basi convexa, sub-levigata, ad peripheriam obsolete carinata.

Spiral angle 22°- 24°; sutural angle 8°.
Height of last whorl : total of shell (considered as 1·00) ... ... 0·26.
Height of penultimate whorl : height of spire (considered as 1·00) ... 0·20.
„ „ „ : its width („ „ „) ... 0·61.

The three sharp keels, placed at equal distances on the space of the whorls, are very characteristic of this species. The sutures are always very deep, and the median convexity increases in proportion, as the strength of the keels or ridges lessens. The tuberculations of the keels are never very strong, sometimes

not stronger, than the ordinary thickness of the striæ of growth would produce. On the last whorl all the keels very often disappear, and in some specimens they become considerably thinner even on the penultimate whorl, while in other specimens they seem to have never attained to any great strength. In large and fully grown specimens there appears sometimes on the last volutions an additional thinner keel along the posterior suture, and a similar one is also generally to be found near the anterior suture.

The base of the last whorl is strongly convex, almost smooth, and on the periphery generally provided with a slight and smooth keel. The aperture is roundish-oval, with very thin margins, the outer lip is anteriorly somewhat produced and laterally deeply insinuated, in conformity with which insinuation all the striæ of growth are bent. D'Orbigny's *T. simplex* or *subsimplex* is evidently founded upon a specimen, on which the spiral ridges had either not been strongly developed, or had been worn of, their markings being, however, clearly traceable.

Locality.—Moraviatoor, Coonum and Veraghoor, in Trichinopoly district, in calcareous sandstones; near Streepermatoor, about 24 miles W. by S. of Madras, in light coloured sandstones.

Formation.—Ootatoor and Trichinopoly groups, to one of which probably also the beds of the last named locality belong.

XXIII. *Family,—SCALIDÆ.*

Scalidæ, H. and A. Adams, Gen. I, p. 220; *Scalariadæ*, Gray, Guide, 1857, p. 52; *Scalaridæ*, Chenu, Man. p. 217.

The animals in this family very much resemble those of the *Turritellidæ*, with the exception, that the proboscis is usually much stronger and fleshy; the mantle is enclosed and has often a rudimentary fold in front; a longitudinal groove on the hinder part of the foot is usually considered to be characteristic of the genus *Scala*; the front part of the foot is more expanded, than in the animals belonging to the last family. The greatest difference between the two is, however, exhibited in the dentition, the teeth of the *Scalidæ* being all uniform, hook-like, placed in many series, the outer being at the same time somewhat larger.

H. and A. Adams state, that the animals are predaceous, and this has probably induced them to place the family in the neighbourhood of the *Cassididæ*. Certainly the predaceous habits of the animals are not very consistent with the phytophagous life of the families, among which they are here placed, but in such cases it is perhaps advisable to lay more weight upon the general character of the organisation and the form of both the shells and animals, than solely upon their mode of living. Troschel classes the *Scalidæ* in the order Ptenoglossa.

The operculum is horny and pauci-spiral.

The shell is spiral, turreted; the whorls convex, usually with numerous transverse ribs; the aperture round, with the margins entire, somewhat thickened and anteriorly often more or less obsoletely effuse.

The existence of transverse ribs and the thickened margins of the aperture generally serve as a good distinction between the species of this and the previous family. The species of the *Scalidæ* live in all waters, but are more numerous within the tropics, than in the temperate zones.

The following genera are at present known :—

1. *Funis*, Seeley, 1861 (Ann. Mag. Nat. Hist. 3rd Ser. VII, p. 285).

Shell turreted, thin; whorls ornamented with transverse laminar ribbings and usually also with spiral striæ, so as to produce a cancellated surface ; aperture ovate, with thin margins, anteriorly sub-effuse.

This genus is based upon a form intermediate between the *Turritellidæ* and the *Scalidæ*; it has the thinness of the shell and the spiral striation of the former, and the laminar transverse ribs of the latter. The transversal ornamentation appears to be, however, the more important distinction between the two families, because it is connected with an expansion of the edges of the mantle, and on that account it seems more appropriate to place *Funis* in the *Scalidæ*.

Mr. Seeley describes two new species, *Funis elongatus* and *? Funis brevis* (loc. cit., p. 285, pl. 11, fig. 7, and p. 286, pl. 11, fig. 8), which latter species does not appear to differ essentially from the former. The presumed *Rostellaria elongata*, Sow. (Trans. Geol. Soc., Lond., 2nd Ser. IV, pl. 11, fig. 16,) could possibly be another cretaceous species of *Funis*. Of other shells, which most likely belong to this genus, we could only quote the *Turritella crispula*, Sandberger, (Conch. des Mainzer Beckens, 1863, p. 117, pl. 12, fig. 3), which was found in a marine sand of the Mayence basin.

2. *Crossea*, Adams, 1865 (Ann. Mag. Nat. Hist. XV, p. 323) ; *shell turbinate, umbilicated, white; whorls convex, cancellated, simple or with varices; aperture roundish, anteriorly angular, somewhat produced and canaliculated; umbilicus surrounded and narrowed by a callus.* The two species, *C. miranda* and *bellula*, were procured in the Japan seas, in 64 fathoms, near the Gotto Islands. The cancellated structure of the shell evidently recalls the ornamentation of *Funis*.

3. *(Amcæa)*, H. and A. Adams, 1853 (Gen. I, p. 223, non *Acmæa*, Escholtz, 1833) ; *shell thin, when young only spirally striated, like Turritella, the last whorls with some transverse ribs; columella tortuous ; aperture roundish as in Scala, but with thinner margins.*

4. *Acirsa*, Moerch, 1858 (H. and A. Adams' Gen. II, p. 621); *shell thin, varices obsolete, outer lip thin, simple.*

5. *Acrilla*, Adams, 1860 (Proc. Zool. Soc., Lond., XXVII, p. 241); *shell moderately thick, with very numerous, equal, transverse ribbings, basis distinctly keeled at the periphery, outer lip thin.* The type is *Ac. (Scal.) acuminata*, Sowerby, and the two other species *Ac. (Chem.) grandis*, Adams and Reeve, and *Acrilla gracilis*, Adams.

6. *Cirsotrema*, Moerch, 1853 (H. and A. Adams' Gen. I, p. 223); *surface cancellated; with few, far distant, strong varices.*

7. *Scala**, Klein, 1753 [*Scalaria*, Lamck., 1801,] (H. and A. Adams' Gen. I, p. 220); *varices numerous, strong, equal; apertural margins thickened, continuous.* The sub-genera, *Clathrus*, Oken, and *Opalia*, H. and A. Adams, may serve as sub-divisions of *Scala*, but it would be scarcely possible to give them generic value, unless the separation is carried out into much greater detail.

8. *Eglisia*, Gray, 1840 (H. and A. Adams' Gen. I, p. 354); *whorls spirally striated with some sub-obsolete, transverse varices; aperture roundish, internally with thickened lips.* We believe with Deshayes and others, that the species known under this generic name are more related to *Scala*, than to *Turritella*, and we therefore place them here. The species, however, quoted by Deshayes under *Scalaria* (Anm. s. vert. Foss. de Paris, 2me. edit., Vol. II, p. 353), in his sub-division *Eglisia*, both probably belong to *Mathilda*, Semper, while those described under *Pyrgiscus* are true *Eglisiæ*. As regards the general form of the shell, most of the species of *Eglisia* exhibit very remarkable relations to *Stephopoma*, Moerch, of the *Vermetidæ*, to which they form a connecting link.

9. *Chilocyclus*, Bronn, 1850 (Lethæa, Vol. II, p. 75, *Cochlearia*, Brown, 1841, apud Münster; non *idem*, Klein, 1753, and others). *Shell moderately thick, with obsolete or small tubercle-like varices, aperture circular with the margins united, internally thickened and expanded.* The name *Cochlearia* has not only been used in Botany, but some time ago by Klein also in Conchology, and was therefore rejected by Bronn for the designation of a new genus, which had to be renamed. The genus includes only two triassic species, *Ch. carinatus*, Bronn, and *Ch. Bronni*, Klipst. *Pterostoma*, Desh. (Paris Foss., 2nd edit., Vol. II, p. 428,) of the *Rissoidæ* is a related form, but it has the anterior portion of the aperture more produced, while the internal space of the same is not circular, and thus it approaches more nearly to other true *Rissoidæ* (vide postea).

10. *Scoliostoma*, Bronn, 1838 (vide Sandberger's Rhein. Schichtensystem, p. 222,) is chiefly known from palæozoic species. The shell is like *Chilocyclus* with the united margins of the aperture largely expanded, but the last whorl is irregularly produced and the aperture reflected upwards or laterally. Should the irregularity of the last volution be proved to have no generic value, both this and the last named genus will have to be united under the name of *Scoliostoma*.

11. *Constantia*, A. Adams, 1860 (Ann. Mag. Nat. Hist. V, p. 300,) a form somewhat resembling *Eglisia*, *with decussate transverse and spiral ribbings.* The genus is founded upon a recent shell from the seas of Japan.

12. *Compsopleura*; we are acquainted with this generic name merely from Conrad's Check list of eocene fossils, p. 15; Smith. Miscell. Coll. No. 200, 1866. The species quoted is *C. trinodosa*, Con., from the so called lower eocene beds, which have been shown by Gabb and others to be partially cretaceous.

13. *Scalina*, ibid, p. 29, with the species *Sc. triquintinaria*, Con., from the upper eocene beds of Vicksburg.

* *Vide* Ostrac., p. 52, pl. 3, fig. 66. There could never have been a mistake as to the real signification of the name *Scala* of Klein.

The *Scalidæ* are only doubtfully represented in the jurassic period, but many very characteristic forms are to be found already in the lowest cretaceous beds, and from that period they gradually increase up to the present time.

Pictet and Campiche (Mat. p. l. Pal. Suisse, 3me. Ser., p. 336, etc.) enumerate thirty European cretaceous species, some of which are, however, very doubtful, though most of them belong probably to this family and especially to *Scala*. To this number have to be added *Sc. compacta*, (Dixon, Geol. of Sussex, p. 349, pl. 27, fig. 32) with numerous thin, transverse ribs, like *Acrilla*, and *Sc. albæ-cretæ* Tate, (Quart. Journ. Geol. Soc., London, 1865, XXI, p. 38, pl. 3, fig. 6) from the cretaceous deposits of Ireland. *Sc. canaliculata*, Vilanova, was identified by Coquand with *Cerith. Forbesianum, D'Orb.* (Mon. Étage Aptien, 1866, p. 85).

Of African species there is only one known. From North America six are quoted by Meek, (Check list cret. and jur. foss., 1864, p. 20) namely, *Sc. annulata*, Morton; *Sc. bicarinifera*, Shumard; *Sc. cerithiformis*, Meek and Hayden; *Sc. Forshayii*, Shum.; *Sc. lamarensis*, Shum.; *Sc. Sillimani*, Morton; to which has to be added *Sc. Mathewsonii*, Gabb (Pal. Calif. 1864, I, p. 212, pl. 32, fig. 278). I have compared in the museum at Bonn the original of the *Sc. Texana*, Römer,—placed by Meek in his Check list, etc., p. 20, under *Chemnitzia*,—and found, that it is based upon an imperfect specimen of an *Aporhais*. The *Sc. Chilensis* was first described by D'Orbigny as a tertiary species, but the author does not say upon what ground he transferred it (Prodrome II, p. 216) into the Senonien. A similar doubt exists with regard to *Sc. Auca*, D'Orb. and *Sc. Pattonii*, Gabb (Proc. Am. Phil. Soc., Philad., VIII, p. 135), whether they are cretaceous or tertiary species!

The South Indian cretaceous deposits have yielded four species; one already described by Prof. Forbes and named subsequently by D'Orbigny *Sc. subturbinata*; two species, *Sc. Clementina*, Mich., and *Sc. striatocostata*, Müller, are to all appearance identical with European forms; and one is new, which has been named *Sc. Shutanurensis*.

Thus the number of cretaceous species of *Scalidæ*, as at present known, will be about forty-five.

XLIX.—SCALA, Klein, 1753.

1. Scala Clementina, *Michelin*, sp. (var.?), Pl. XVIII, Fig. 1.

1842. *Scalaria Clementina*, D'Orbigny, (*Melania id.* Michelin), Pal. Franç., crét. II, p. 52, Pl. CLIV, Figs. 6-9.

It is possible, that we have this characteristic gault species represented in India, but the single figured fragment is so very incomplete, that we cannot vouch for its identity. The only difference between ours and D'Orbigny's figure is the smaller spiral angle of the latter shell, but the form of the whorls with their posterior contraction, the number of transverse ribs varying from twelve to fourteen and disappearing on the posterior suture, do not show any difference from those in the European form. It is sufficient for the present to draw attention to this species, and defer its exact determination until the discovery of better materials.

Locality.—The figured fragment was found in the calcareous sandstones North of Odium in the Trichinopoly District.

Formation.—Ootatoor group.

2. Scala subturbinata, *D'Orbigny*, Pl. XVIII, Figs. 2-3.

1846. *Scalaria turbinata*, Forbes, Trans. Geol. Soc., Lond., VII, p. 124, Pl. XII, Fig. 18 (non *idem* Conrad).
1850. „ *subturbinata*, D'Orb., Prod. II, p. 217.
1861. „ *Haidingeri*, Binkhorst, Mon. Gast. et Ceph. Limbourg, p. 36, Pl. II, Fig. 4.

Sc. testa turbinate-conica; anfractibus valde convexis, transversaliter costatis, spiraliter minute striatis, costis 14-15 *in un circuitu, crassis, prope rectis, carinam ad peripheriam basis ultimi anfractus sitam transeuntibus; striis alternatim fortioribus et tenuioribus; apertura ovate rotundata, antice paulo producta, sub-effusa; marginibus parum expansis.*

Spiral angle 35°; sutural angle 10°.				
Height of last whorl	: total of shell ...	... (considered as 1·00)	...	0·35.
Height of penultimate whorl	: height of spire	(„ „ „)	...	0·29.
„ „ „	: its width	... („ „ „)	...	0·48.

The characteristics of this species consist in the short conical form, great convexity of the whorls, strong transversal ribs and alternately stronger, but comparatively fine, spiral striæ. The ribs cross on the basis of the last whorl a thin keel, which is placed near to, but not quite on the edge of, the periphery, and continue towards the centre, decreasing gradually in thickness. The edge of the transverse ribs is originally sharp, but when, with advancing growth, it wears off gradually, the ribs appear rounded, as usual in species of *Scala;* sometimes this edge is, however, broken off, and in such cases a furrow appears in the middle, indicating the separation of the two lamellæ, which compose each of the ribs. All these characters agree so exactly with Binkhorst's figures and descriptions, that it is impossible to point out a difference between the two fossils. An examination of Binkhorst's originals has confirmed this statement. Forbes' figure is not characteristically drawn, and might be applied rather to the next species, but the original specimen in the London Geol. Soc. Collection belongs certainly to this. It is instantly recognised by the coarser spiral striation. In our small specimen, represented in Fig. 2 on Pl. XVIII, the aperture is perfect, being roundish-oval, anteriorly somewhat produced, sub-effuse, with slightly enlarged margins.

The beds from which the species has been described by Binkhorst belong to the characteristic Maestricht Chalk. Prof. Forbes' original specimen appears to be from the Verdachellum sandstones.

Locality.—S. W. of Arrialoor, in whitish siliceous sandstone; rare.

Formation.—Arrialoor group.

3. Scala striatocostata, *Müller*, Pl. XVIII, Figs. 4-5.

1851. *Scalaria striatocostata*, Müller, Petref. Aachner Kreidef., pt. II, p. 7, Pl. V, Fig. 3.

Sc. testa turbinate-conica; anfractibus valde convexis, 15-18 *costis transversalibus, tenuibus, lente curvatis, atque striis minutissimis spiralibus ornatis: costis in basi ultimi anfractus prolongatis, sed multo tenuioribus; basi sub-convexa et prope peripheriam carinata, sectione anfractuum rotundata.*

Spiral angle 27°- 32°; sutural angle 8°.

		Fig. 4.	Fig. 5.
Height of last whorl : total of shell ... ... (considered as 1·00)	...	0·32	— 0·32.
„ „ penultimate whorl : height of spire („ „ „)	...	0·22	— 0·26.
„ „ „ „ : its width ... („ „ „)	...	0·47	— 0·45.

This species is readily distinguished from *Scala subturbinata*, D'Orb., by having the transversal ribs more distinctly curved, thinner and sharper, and the spiral striation much finer; the basal keel of the last volution is placed somewhat nearer to the periphery, than is the case in the previous species. The fine spiral striæ are very easily worn off, although the specimens appear to be otherwise well preserved. The number of transverse ribs is about 15 in one whorl of the elongated specimens, and increases to 18 in shorter ones (comp. Figs. 4 and 5). There is otherwise no difference between these two forms.

The figure given by Prof. Müller is very indistinct, but having lately had an opportunity to examine the rich collections of Aachen fossils belonging to that gentleman, I have been able to prove the identity of both.

Localities.—Olapaudy and Comarapolliam, in light coloured sandstones; rare.

Formation.—Arrialoor group.

4. Scala Shutanurensis, *Stoliczka*, Pl. XVIII, Figs. 6-8.

Sc. testa elongate-turbinata, crassa; anfractibus convexis, transversaliter 12-15*—costatis, antice ad marginem interdum subcarinatis, spiraliter striatis: costis crassis prope rectis; striis inæqualibus, circiter octonis fortioribus atque multis tenuioribus interpositis; basi ultimi anfractus paulo producta, subconvexa, costis tenuibus atque striis spiralibus ornata, ad peripheriam carinata; sectione anfractuum rotundata.*

Spiral angle 24°- 25°; sutural angle 10°.

Height of last whorl : total of shell ... ... (considered as 1·00)	...	0·31.
„ „ penultimate whorl : height of spire („ „ „)	...	0·25.
„ „ „ „ : its width ... („ „ „)	...	0·48.

In general form of the whorls and in the number of transverse ribs the Indian species very much resembles the European *Sc. Dupiniana*, D'Orb. (Pal. Franç. terr. crét. II, p. 54, pl. 154, figs. 10-13), but the spiral striation is in this last named species always finer and more uniform.

The anterior margin of each whorl has sometimes along the suture a keel visible, which is specially strongly developed on the periphery of the basis of the

last volution. The *Sc. ornata*, Baily (Quart. Journ. Geol. Soc., Lond., 1855, XI, p. 459, pl. 12, fig. 2), from South Africa is extremely like, but differs in having the spiral striation also more uniform, and comparatively finer.

Localities.—Shutanure, E. of Anapaudy, N. of Alundanapuram, and N. of Serdamungalum, in brownish or greyish sandstones; not very common.

Formation.—Trichinopoly group.

XXIV. *Family,—CÆCIDÆ.*

H. and A. Adams' Genera I, p. 355, and others.

Dr. Gray's classification of the *Cæcidæ*, immediately after the *Rissoidæ*, is well supported by forms, like *Skenea* and others, the animals of which, as likewise the young shells, are exceedingly similar in form. Viewing, however, other apparently more closely related families to both these two, it would seem more suitable to place the *Cæcidæ* after the *Turritellidæ*, or at least in close connection with the same. Clark (Brit. Hist. Moll., p. 323) notes specially the great similarities in the organisation of *Cæcum*, *Vermetus*, and *Turritella*.

Deshayes in his recent edition of the Paris fossils (Vol. II, p. 278,) introduces Cuvier's name of Tubuli-branchiata, as a sub-order, for this and the following two families, which he admits only as genera in his family Tubispirata. Cuvier's name refers to a certain form of the gills, which, however, are not in any particular way differently formed from those of the *Turritellidæ* and others. On the contrary, Mr. Deshayes' arguments in favor of the Tubuli-branchiata refer chiefly to the irregularities and to the adhering of the shells to foreign objects, the small or rudimentary foot, united sexes and other characters, which merely depend upon the mode of living. If these ought to form the characters of Cuvier's sub-order, it is evident, that the *Cæcidæ* must be excluded from it, inasmuch as they are mostly free;—at least in their full grown stages of age.* The animals have the foot terminating with a small creeping disc, and move with the assistance of the long head almost as quickly as do the *Assimineæ*. It would be, therefore, rather inconsequent and at the same time unjustifiable to admit the so-called genus *Cæcum* into Deshayes' proposed family Tubispirata, which cannot replace the three families which we adopt here, namely, *Cæcidæ*, *Vermetidæ*, and *Siliquariidæ*.

Carpenter in his admirable Monograph of the *Cæcidæ* (Proc. Zool. Soc., Lond., 1858, p. 413, etc.,) proposed in this family four genera:—

1.—*Cæcum*, Fleming, 1817.

2.—*Brochina*, Gray, 1857.

3.—*Meioceras*, Carpenter, 1858.

4.—*Strebloceras*, Carpenter, 1858.

* It is only supposed by Mr. W. Clark, (Hist. Brit. Moll., p. 325), the first observer of the animal of *Cæcum*, that they are probably attached when young. See also Gray's Guide, 1857, p. 101.

There are about 70 living species known, chiefly from the tropical seas of America, and most of them have been only lately described in the 'Journal de Conchyliologie.' Being mostly small shells and, when adult, living principally in deep waters, they are difficult to procure. Of fossil species about 15 are known from tertiary beds, of which several cocene species belong to *Strebloceras*. We are not acquainted with any cretaceous species, although straight fragments of the shells of *Cæcidæ* may have been occasionally described as *Dentalium*. For it is nearly as probable, that fragmentary tubes like *? Dent. rugosum*, Müller (Aach. Petref., 1851, pt. II, p. 6, pl. 3, fig. 2) belong to *Cœcum* or *Fistulana*, as to *Dentalium*.

I may also mention here the genus *Burtinella*, which is placed by Mörch in the *Vermetidæ*, and will be found treated in that family with greater detail. So far as we know *Burtinella* at the present, it includes chiefly *spirally coiled shells with tubular whorls, the last of which extends freely, more or less in a straight direction*. The fossil shells belonging to that genus seem to have been *attached only in the first stage of age*, and were *subsequently free;* but as they are much more strongly built, than the *Cæcidæ* usually are, they were probably litoral inhabitants, like most of the *Vermetidæ* are. Still the characters of the shell of *Burtinella* agree in general far more with *Meioceras* and *Strebloceras* of the *Cæcidæ*, than with any known *Vermetidæ*. We do not know whether the first whorls of *Burtinella* were concamerated, but if they were not, there is scarcely any reason to exclude *Burtinella*, and probably also *Tubulostium* (n. genus,) from the family *Cæcidæ*. Not being in possession of any other materials for examination, than the fossil species from South India, so as to test the value of our suppositions, we do not at present make any change in the classification.

XXV. *Family,—VERMETIDÆ.*

H. and A. Adams' Gen. I, p. 356; Gray, Cat., 1857, p. 126.

The body of all the *Vermetidæ* is elongated, more or less cylindrical and differently twisted, the mantle with the margins entire, embracing the neck; foot truncate, cylindrical, club-shaped, not adapted for locomotion, and therefore occasionally rudimentary; gills enclosed in a cavity on the left side, or near the middle of the back; tentacles short, pointed; eyes small, usually at their external basis, often on small bulgings; rostrum produced, teeth, so far as known, placed in seven rows.

Operculum, if present, spiral and horny.

The *embryonal shell is always spiral and often reverse to that of later growth*, when the more or less tubular whorls become twisted and coiled in various ways. Regularly coiled shells are to be met with in species, which are, only during the embryonic stage of life, attached, and afterwards free. These shells are then evidently closely allied to true *Cæcidæ*. In other species, which are fixed during their entire life, the coiling and form of the tube itself very much depends upon the object, to which they are attached.

It is hardly necessary to repeat the complaints, which are made by every naturalist, when determining shells belonging to the family of the *Vermetidæ*, as distinguished from those of the Annelide *Serpulidæ*. Mörch,* who studied the former family in all its accessible specialities, says (Proceed. l. c. 1861, p. 145,) that the shells of the *Vermetidæ* are at once to be distinguished from those of the "*Serpulæ by the presence of a spiral, nuclear shell and of concave smooth interior septa;*" and further on, p. 146, "*the Serpulidæ appear only to be composed of two layers, the Vermetidæ having three.*"

These distinguishing characters may be appropriately used, when the shells are perfectly preserved, which is unfortunately not always the case with fossils; still they are for us more important than all the others, which relate to the animal, the operculum and the form of the aperture. It is a matter of course, that the different forms of the living *Vermetidæ* must in general assist us in determining the fossil remains of the same group.

With regard to their classification in the system of Mollusca there exists a great controversy between conchologists, as may be seen from a reference to the treatises in H. and A. Adams' 'Genera;' Chenu's 'Manual;' Gray's 'Guide, 1857;' Pictet's Traité de Pal., *and* Pal. Suisse, 3*me. Ser.;* Deshayes' Anim. s. vert., basin de Paris, 2me. Edit., 2me. Vol.; and others. Gray forms in his sub-order Rostrifera a separate higher division under the name of Ptrotopoda, and divides the family *Vermetidæ* into two sub-families, *vermetinæ* and *siliquarinæ*. Deshayes proposes in the sub-order Tubulibranchiata of Cuvier only one family, *Tubispirata*, with four genera, *Vermetus*, *Serpulorbis*, *Siliquaria*, and *Cæcum*. H. and A. Adams unite also *Siliquaria (Tenagodus)* with the *Vermetidæ*, while Chenu separates these two. Such separation in *Cæcidæ*, *Vermetidæ* and *Siliquariidæ* seems according to our present knowledge of the respective animals and shells, absolutely necessary, as stated also in the remarks accompanying the two other families.

Not less difference of opinion exists with reference to the number and the names of genera, which have to be admitted into the family *Vermetidæ*. Mörch's latest researches, as published in the Proc. Zool. Soc., London, for 1861 and 1862, must be looked upon as the most important and leading, because they treat the subject in the historical point of view, and also in the examination of the shells or animals, in far greater detail, than those of any previous writers. These researches cannot, of course, be regarded as concluded, for besides the living species there are left an extensive number of the fossil forms, of some of which it is actually at present impossible to say, which are Annelids, and which are Gastropods. Mörch distinguishes eight genera in the family *Vermetidæ*, namely, *Burtinella*, *Stephopoma*, *Siphonium*, *Vermiculus*, *Spiroglyphus*, *Vermetus*, *Bivonia, and Thylacodes*, to which we add a new one under the name of *Tubulostium*.

* Journal de Conch., Vol. VII, p. 342, and Vol. VIII, p. 27.—Proceed. Zool. Soc., Lond., for 1861, pp. 145 and 326; and for 1862, p. 54.

The family will be found most probably represented already in the palæozoic formations, from which Serpuloid shells are numerously reported. From the Trias several species of *Vermetidæ* are well known, and they gradually increase in number through the successive formations. When speaking of the fossil forms, it must also be taken into consideration, that their imperfectness on one hand, and the uniformity in structure with others, very often prevent the exact determination of the species. The uncertainity of distinction between a Gastropod and an Annelid diminishes also the interest, which would be otherwise paid to them.

We give here a short review of the characters of those genera, which are represented in cretaceous rocks, appending a few notes upon the others, as to their value in the conchology of fossil remains.

1. *Tubulostium*, Stoliczka, 1868.

Testa libera, solida sublevigata, planorboidea seu late conica, sæpissime sinistrorse–, rare dextrorse-torta; anfractibus interne tubulosis, externe callositate junctis, in superficie rotundatis seu carinatis; apertura valde atque abrupte contracta, tubulosa, rostriforme prolongata.

The principal characteristic, upon which this genus is proposed, consists in the *narrow* and *tube-like prolonged aperture*. The form of the shells varies from planorboid to broadly conical. The embryonal whorls are distinctly spirally coiled, but not any of the very numerous specimens of the two species give a decided proof, that they have been attached to any foreign object. These embryonic whorls are, however, often worn of. In advanced age the shells were evidently quite free, and thus it is not unlikely, that they had a somewhat more developed foot, than other attached *Vermetidæ*, and approached, in this respect, the family *Cæcidæ*.

The internal space of the whorls is tubular, but externally the callosity is generally largely developed. In a microscopical section the shell distinctly shows three layers, of which the middle one is somewhat thicker, than the internal or external one. These two thinner layers appear to be composed of a rather consistent [milky white] substance, while the central one seems to present some kind of transverse striation, as if indicating the succeeding layers of growth, though these distinctions are not sufficiently clear to be observed. The outer or callous mass is quite homogenous. The Gastropodous character of these shells is pronounced, as already stated, in the *spiral nuclear whorls* and *the three layers* of which they are formed. The callosity has also more probably been deposited from the mantle of a Gastropod than from an Annelid. We are not acquainted with any living species, which possesses a similar tubular aperture, to that known in the fossil forms. Of these the *Serpulæ*, like *S. spirulæa*, Lamarck, will probably have to be placed in this genus, although I am for the present unable to compare good specimens of this species with our originals. The jurassic *Verm. tumidus*, Sow., is certainly a *Tubulostium*. The *Spirorbis leptostoma*, Gabb (Journ. Ac. Phil., 2nd Ser., Vol. IV, p. 385, pl. 67, fig. 36 (not 41), from the American tertiaries, would seem to belong also to this genus; and several others may be found subsequently. The two new species from South India are *T. discoideum* and *T. callosum*.

2. *Burtinella*, Mörch, 1861, (Mœrchia, Mayer, Journ. de Conch., Vol. VIII, p. 309).

Burt. testa adulta libera, anfractibus primis in ætate juniore affixa, crassa, late-conico elevata, trochiformi seu planorbulari, plerumque sinistrorsa, rariter dextrorsa; anfractibus gradatim ac regulariter crescentibus, interne tubulosis, externe aliquanto angulatis, striis incrementi tenuioribus atque fortioribus instructis; ultimo ab ceteris sæpissime dissoluto atque plus minusve prolongato, haud constricto; apertura circulari, marginibus junctis, attenuatis.

If the shells of *Burtinella* were free and litoral inhabitants, it is probable, that they had the end of the foot more of the shape of that found in the *Cæcidæ*, so as to enable them to move about. Judging from the section of the whorls of *B. concava*, (Pl. XVIII, Fig. 12), the shells are composed of three layers, of which the middle one is very thick, and the external and internal comparatively thin. The state of the fossil shells at my disposal does not admit of observing any difference in the almost homogeneous structure of these three layers.

The genus has been founded on the *Solarium Nystii*, Galeotti *(Vermetus id.* Nyst., Polyp. Foss., Belg., II, p. 373, pl. 36, fig. 8). Except one doubtful species figured in Humphrey's Conchology, pl. 10, fig. 8, all the others are known only in a fossil state. Mörch quotes only six species (three tertiary, two cretaceous, and one oolitic), which number will be increased considerably. The cretaceous species, as at present known, are—

1. *Burt. Sowerbii*, Mant. (Sth. Downs, 1822, p. 111, pl. 18, figs. 14-15).
2. *Burt. subrugosa*, Münst. (Goldf., Pet. Germ. I, pl. 71, fig. 1), is allied, if not identical, with the previous species.
3. *Burt. granulata*, Sow. *(Serpula id.* Min. Conch., Vol. VI, pl. 597, fig. 8). Römer unites with this the *Sp. crenato-striata*, Münster (Goldf. Pet. Germ. I, pl. 71, fig. 2, and Römer in Verst. Nord. Kreide., 1841, p. 102).
4. *Burt. Philipsii*, Römer, (*Verm. Sowerbii* in Phill's. Yorksh., pl. 2, fig. 29; Römer, loc. cit. p. 102).
5. *Burt. umbonata*, Sow. (Min. Conch. *Vermicularia* id. I, p. 126, pl. 57, figs. 6-7), from which the *Verm. umbonata* in Mantell's Foss. Sth. Downs, p. 111, pl. 18, fig. 24, looks not very different, though it has a smaller number of stronger and more distant transversal ribbings.
6. *Burt. concava*, Sow., an Upper Greensand species, which is also found in our Sth. Indian deposits.
7. *Burt. conica*, Hagenow, Bronn's Jahrb., 1840, p. 666, pl. 9, fig. 15.
8. *Burt. trochiformis*, Hagenow, *ibidem*, fig. 14.

If any of the species with externally carinated whorls belong to this genus the following species will have to be added:—

9. *Burt. polygonalis*, Sow., Min. Conch. VI, pl. 596, fig. 6.
10. *Burt. unilineata*, Röm., Norddeutsch. Kreide., 1841, p. 102, pl. 16, fig. 2.
11. *Burt. quinquecarinata*, Römer, *ibidem*, fig. 3.

The *Planorbis radiatus*, (*Vermicularia*, Lamck.), Min. Conch. II, pl. 140, fig. 5,) is a *Helicocryptus*, belonging to the family *Umboniidæ*.

3. *Stephopoma*, Mörch, 1860. (Proc. Zool. Soc., Lond., 1861, p. 148).

The shells, which belong to this genus, are generally very small, and usually so tender, as to be very rarely found fossil in a good state of preservation. Besides

this the single shells are with great difficulty distinguished from *Vermiculus*. Judging from the exterior form only, it appears very probable, that the *Vermetus cochleiformis*, Müller (Monog. Petræf. Aach. Kreide., II, p. 6, pl. 3, fig. 3,) belongs to this genus.

4. *Siphonium*, Mörch., 1861—? Browne, 1756. (Proc. Zool. Soc., Lond., 1861, p. 152).

If it be proved that none of the shells, which had been called *Siphonium* by Browne, belong to this genus, as established by Mörch, the name ought to be better replaced by some of the latter synonyms.—We are not acquainted with any cretaceous form, which would belong to this genus.

5. *Vermiculus*, Lister, 1688. (Mörch in Proc. Zool. Soc., Lond., 1861, p. 169).

The shell of this genus is characterised by being in the early stage of age *regularly coiled like a Turritella*, and afterwards with the *last whorl uncoiled, variously twisted, or more or less straight and prolonged.* There is apparently no other distinction between the shells of *Vermiculus* and *Burtinella*, except that the latter are coiled in a broad, largely umbilicated cone.

There are several tertiary species, which from their great affinities with the living shells are correctly classed in this genus. In the determination of the cretaceous species more difficulty is experienced. We know at present four European species, which very probably should be classed here: *Vermiculus Rouyanus*, D'Orb., sp.; *V. albensis*, D'Orb., sp.; *V. Sanctæ-crucis*, Pict. et Camp. and *V. gaultinus*, Pict. et Camp. (vide Pal. Suisse, 3me. Ser., p. 344). To these has to be added the Indian species, *Vermetus anguis*, Forbes (vide p. 243). Several species of *Vermiculus* are known from jurassic beds, and from the Trias, species like *Scoliostoma fasciatum*, Hörnes, (Denksch. Akad., Wien, 1856, Vol. XII, pt. II, p. 30, pl. 3, figs. 7-8), and even *Sc. moniliferum*, Hörnes, *ibidem*, fig. 6), have probably to be added to *Vermiculus*.

6. *Spiroglyphus*, Daudin, 1800. (Mörch Proc. Zool. Soc., Lond., 1861, p. 1326).

This genus is very numerously represented fossil, but as yet little known. Of cretaceous species only the *Vermetus clathratus*, Binkhorst (Gast. et Ceph. Limbg., 1861, p. 35, pl. 5^{a2}, fig. 3), is probably a *Spiroglyphus*, judging from its relation to *Sp. glomeratus*, Bivona.

7. *Vermetus*, Adanson, 1757. (Mörch in Proc. Zool. Soc., Lond., 1861, p. 334.

Adanson (Hist. Nat. Senegal, p. 160, pl. 11), figures different forms under this generic name, but, as for some of these Lister's denomination of *Vermiculus* has already been applied, Mr. Mörch consequently retained the name *Vermetus* only for those species, which have *folds on the columellar margin.*

Mörch distinguishes two sub-genera, *Vermetus*, Adans., and *Petaloconchus*, Lea, with two other sub-divisions, *Thylacodus* and *Aletes;* but he remarks himself, that the recorded distinctions are not constant, and that one form passes into the other during different stages of age.

There are several fossil tertiary species, which belong to *Vermetus* proper, but I am not acquainted with any from cretaceous deposits.

8. *Bivonia*, Gray, 1850. Mörch (Proc. Zool. Soc., Lond., 1862, p. 54).

The shells, if not perfect with the margins of the aperture, are very difficultly distinguished from *Spiroglyphus*.

9. *Thylacodes*, Guettard, 1774. (Mörch, Proc. Zool. Soc., Lond., 1862, p. 64).

Testa plerumque solitaria, repens, quandoque spirata, sæpe liris 3-5, *longitudinalibus, nodulosis ornata; apertura circularis, nunquam contracta. Testa nuper nata bulimoidea, apertura antice subeffusa* (Mörch).

This genus is largely represented among living shells; it mostly contains the irregularly coiled species, although they are generally spiral, when young. From the tertiary beds several are known. The greater number of *Serpulorbis*, lately described by Deshayes from the Paris basin, belong to *Thylacodes*, in the sense in which the genus has been determined by Mörch.

A very characteristic species has been procured from the Arrialoor beds near Comarapolliam, *Th. lamellosus*, n. sp. There are besides several fragmentary specimens of species, belonging to this genus, from the Ootatoor beds near Odium and Moraviatoor, but they must for the present be left undetermined, until better materials can be obtained.

L. TUBULOSTIUM, *Stoliczka*, 1868, (vide p. 237).

1.—Tubulostium discoideum, *Stoliczka*, Pl. XVIII, Figs. 20-25.

Tub. testa discoidea, planorbulari, anfractibus quinis seu senis, angulatis ad peripheriam obtuse convexis, supra atque infra, et ad marginem suturalem subcarinatis, callositate tenui junctis, sublevigatis; striis incrementi in dorso convexe curvatis, interdumque nonnullis sulcis spiralibus subobsoletis interruptis; ultimo anfractu prope rostrum callositate magna instructo; rostro valde contracto atque prolongato.

The diameter of our largest specimens does not exceed 14 mm., and the height of the last volution 2 mm.

This little discoid shell rather more resembles a *Serpula* than a Gastropod, but the three layers of which it is composed, are distinctly traceable, though they are usually very thin. The embryonal whorls, although very seldom preserved, are also distinctly spiral, and the succeeding whorls are coiled in a regular symmetrical plane. They are nearly quadrangular in the outer section, each being attached to the back of the previous one by a thin callose layer, carinate above and below. The last whorl is slightly convex on the outer periphery. The striæ of growth are very fine, so as to be sometimes scarcely traceable. Beside these there occasionally appear on the surface of the shell a few spiral furrows, which are somewhat more distinct on the outer periphery. The last whorl is thickened towards aperture, which contracts suddenly, and extends into a more or less prolonged tube.

The only species, which shows a great relation to our Indian fossil, is the *Vermetus tumidus*, Sowerby (Min. Conch., Vol. VI, p. 195, pl. 596, fig. 4,) from the

Coral-rag near Scarborough. Morris (Cat. p. 94) unites this species with *Ver. concinnus*, Sow. sp., under the name of *Vermicularia compressa*, Young and Bird; but this is scarcely admissible from the drawings of the species. The two last may very probably be identical, but the first is readily distinguished by its strongly contracted tube, into which the aperture is prolonged.

Locality.—North of Odium, in clayey beds, common and characteristic for the

Formation.—Ootatoor group.

2.—Tubulostium callosum, *Stoliczka*, Pl. XVIII, Figs. 26-32.

Tub. testa late conica, levigata, apice acuminata seu obtusa, plerumque sinistrorsa, rarissime dextrorsa; anfractibus callositate crassa junctis, atque precedentes plus minusve tegentibus, ultimo ad peripheriam pronato, tricarinato; basi in medio aliquanto rimata, sæpius callositate tumida tecta; apertura angustata, tubiformi, paulo producta; anfractuum sectione interna circulari.

The basal diameter of the largest specimens does not usually exceed 25mm., and the height 18mm.

The trochoid form of the shell, being generally sinistral, and the great development of the callosity, by which each succeeding whorl attaches itself to, and partly covers, the preceding volution, are very characteristic distinctions of this species. The surface is, save some irregularities in the impressions of the striæ of growth, quite smooth. The embryonal whorls are spiral, somewhat mammillate, though rarely found preserved, being easily broken away. They must have been concamerated, as they are not filled with the substance of the rock, in which they were buried, which would at least occasionally have taken place, if they had been in open communication with the rest of the whorls. There is no direct sign, that the shell was, even in the earliest stage of growth, attached or fixed. The periphery of the last whorl is produced, thickened, and provided with three smooth keels. The centre of the excavated basis is either umbilicated or more frequently covered up with a callosity. The tube, into which the aperture is produced, is never very long, but always distinctly marked. The interior section of the whorls is circular.

I am not acquainted with any species, which could be compared with this remarkable shell. It is evidently the same which Mr. H. Blanford mentions in his report (Mem. Geol. Surv. of India, Vol. IV, pt. I, p. 83) as "a peculiar conoidal-coiled *Serpula*."

Localities.—North of Ootatoor and neighbourhood of Kauray; according to Mr. Blanford common in, and characteristic for, the "clays of the lower beds" of the

Formation.—Ootatoor group.

LI. BURTINELLA, Mörch, 1861. (Vide p. 238).

1.—Burtinella concava, *Sowerby*, sp., Pl. XVIII, Figs. 11-19.

1822. *Vermicularia concava*, Sow., Min. Conch., Vol. I, p. 125, Pl. LVII, Figs. 1-5.

Burt. testa crassa, discoidea, planorbulari seu subturbinata, late umbilicata, plerumque sinistrorsa, rarissime dextrorsa; apice sæpissime detrito; anfractibus 4-5, *rotundatis, ad suturas nonnunquam callositate tenui instructis, transversaliter striolatis, prope aperturam aliquanto cingulis crassioribus nonnullis ornatis, ultimo in adultis terminatione ab ceteris dissoluto, ac plus minusve recte prolongato; apertura circulari, marginibus attenuatis.*

The diameter of the coiled shell measures in the largest specimens from 18-20 mm.

It is impossible to give any specific distinction between our Indian fossil and the one described and figured by Sowerby from the Upper Greensand. The shell, being composed of three distinct layers and having the apex spirally coiled, presents all the characters of a true Gastropod. The form is very variable, generally the apex is found corroded, or in some way or other made indistinct, for the shells were usually attached when young to submarine objects. Specimens with the spiral embryonal whorls preserved are very rarely met with; in a more adult age the whorls are spirally coiled either in the form of a disc or of a short cone, being generally sinistral, very seldom dextral; they form a large open umbilicus, and are either perfectly round or somewhat depressed and joined together with a thin callous substance. It is quite impossible to draw a line between the variations of form, which can be observed in a large number of specimens from the same locality, and which are amply illustrated in our figures. The end of the last whorl is often separated from the previous volution and forms a free, more or less prolonged, tube. The aperture is circular, or nearly so, and the margins sharpened from within. The transverse striæ of growth are generally distinctly marked, occasionally in some places somewhat stronger, and near the aperture of large specimens producing sometimes thick elevated rings.

Several very similar species have been separated under different names, the specific distinctions of which are not always certain. For instance, Sowerby's *Vermicularia umbonata* (M. C., pl. 57, figs. 6-7), seems to be scarcely different from the present species. The same is probably the case with Mantell's *Verm. umbonata* (l. cit. p. 111, pl. 18, fig. 24), which has been transmitted from Mantell to Sowerby, and is from the same locality as the last named.

Another very similar species is *Burtinella Phillipsii*, Römer, sp. (*Verm. Sowerbii* in Phill's. Yorksh., pl. 2, fig. 29), which differs only by its more conical shape. In *Serpula subrugosa*, Münst. (l. cit., pl. 71, fig. 1), the shell appears to have been much thinner, and the inner space of the whorls indented by the convexity of the preceding whorl, which makes it probable, that it is not different from the *Burt. (Vermicularia) Sowerbii* of Mantell (l. cit., pl. 18, figs. 14-15).

Localities.—Olapaudy, Andoor and Veraghoor (yellow sandstones); Kunnanore and Paupanchary, in greyish or yellowish, siliceous sandstones; common.

Formation.—Arrialoor group.

LII. VERMICULUS, *Lister*, 1688. (Vide p. 239).

1.—Vermiculus anguis, Forbes, sp., Pl. XXVIII, Fig. 1.

1847. *Vermetus ? anguis*, Forbes, Trans. Geol. Soc., Lond., VII, p. 124, Pl. XIII, Fig. 1.

Testa anfractibus crassis, sub-rotundatis, sinistrorsis, disjunctis, in superficie exteriore liris spiralibus atque transversalibus decussantibus, subtuberculatis ornatis.

The only known fragment of this species is that originally described by Prof. Forbes. The shell is sinistrorse, very thick, and the whorls have the outer surface ornamented with a number of spiral and transverse ribs, forming at the places of junction more or less sharp and elevated tuberculations. The columellar surface of the whorls is only spirally striated. The striæ of growth are numerous and very fine. The fragmentary specimen of the shell is very likely the lower and more uncoiled portion of a species of *Vermiculus*, because it does not show any place of attachment.

Our representation on Pl. XXVIII is taken from Prof. Forbes' original specimen, now in the collection of the Geol. Soc. of London, as no other of this interesting species has been found since its first discovery by Messrs. Kay and Cunliffe.

Locality.—Pondicherry, in a bluish sandstone.

Formation.—Valudayur—or Arrialoor—group; the last named is probably the correct one.

LIII. THYLACODES, *Guettard*, 1774. (Vide p. 240).

1.—Thylacodes lamellosus, *Stoliczka*, Pl. XVIII, Figs. 9-10.

Thyl. testa irregulariter spirata, adherente, plus minusve acglomerata; anfractibus subtubulosis, paulo depressis, in superficie transversaliter numerose lamellatis, supra interdum spiraliter sub-carinatis; sectione anfractuum ovali.

The tube of this species is spirally coiled in the first stages of age, attached to various submarine objects; in more advanced age it grows rather in a straight direction, and is apparently partially free. The section of the tube is always more or less oval, which is especially the case in the fixed portions of the whorls. The surface is covered with transversal lamellæ, which are evidently the remnents of the enlarged margins of the aperture. On the outer surface there are occasionally present two or three, partially obsolete keels, the rest of the surface being smooth. In young specimens the transversal lamellæ are more distant, but less prominent, than in older ones, and recall very much the form of *Vermicularia umbonata*, Mant. (Foss. Sth. Downs, 1822, p. 111, pl. 18, fig. 24,) from the Chalk-marl of Hamsey.

Locality.—Comarapolliam, in a gritty sandstone; rare.

Formation.—Arrialoor group.

XXVI. *Family,—SILIQUARIIDÆ.*

Chenu (Man., p. 321) introduced this family for the shells known as *Siliquaria*, and we believe, that it ought to be accepted. Some conchologists follow Gray's classification in retaining the sub-family *SILIQUARIINA* in the *VERMETIDÆ*; others do not think even this division necessary, and admit only one genus, either under the name *Siliquaria* or *Tenagodus*.

When we regard the distinctions between *PLEUROTOMARIIDÆ* and *TROCHIDÆ* sufficiently important, to form the basis of two families, it appears to us fully justifiable to make a similar separation between the *VERMETIDÆ* and the *SILIQUARIIDÆ*. The existence of a slit in the mantle of the animal and in the shell, being a canal through which the water is supplied to the branchial plume, seems to be of much greater importance, than, for instance, is the length of the tentacles and eye-pedicles; or whether the position of the nucleus of the operculum is apical or lateral. Mörch in his "Review of the genus *Tenagodus*" (Proceed. Zool. Soc., Lond., 1860, p. 400, etc.) admits four sub-genera—

1. *Agathirses*, Montfort, 1810, which includes chiefly fossil species, and is characterized by the band being composed of numerous, isolated holes.
2. *Tenagodus*, Guettard, 1774, (Mörch, l. cit., p. 402).
3. *Siliquarius*, Montfort, 1810, (Mörch, l. cit., p. 403).
4. *Pyxipoma*, Mörch, 1860, l. cit., p. 409.

'I am much inclined to regard the sub-genera as of generic value,' says Mörch, (l. cit., p. 412), in which we fully concur with that author. We do not see any reason, why characters, upon which genera like *Pleurotomaria*, *Ditremaria*, *Polytremaria*, *Trochotoma*, and others have been established, should prove perfectly valueless in the classification of the *SILIQUARIIDÆ*. Moreover we believe, that the distinctions of genera will be carried still farther than is now proposed, when we come to know more of the fossil species, and of the animals of the recent shells.

More recently (Journ. de Conch., Paris, 1865, Ser. III, Vol. V, p. 13), Mörch says, "il me paraît probable que le tube du *Cryptobia Michelini* est construit par un *Mollusque* voisin des *Tenagodus* et surtout du sous-genre spongicole *Pyxipoma*." The genus *Cryptobia* of Deshayes will, therefore, probably have to be added to this family.

There are about twenty tertiary fossil species known, and Deshayes (Anm. s. vert. bas. de Paris, Vol. II, p. 292), says that one species had been mentioned from the upper cretaceous beds of Taxoe in Norway. I am not acquainted with this or any other secondary species of the *SILIQUARIIDÆ*.

XXVII. *Family,—ONUSTIDÆ.*

H. and A. Adams' Genera I, p. 361; *idem* Chenu; *Phoridæ*, Gray; *Xenophoridæ*, Deshayes.

The question as to the place of this family in the system is by no means settled with the last decision of Deshayes (Anm. s. vertb. foss. bas. de Paris, 2me. ed., Vol. II, p. 958, etc.). Palæontologists were accustomed to look for *Xenophora* in the neighbourhood of *Trochus*, as long as they knew only a few fossil shells. This idea was introduced chiefly through D'Orbigny's 'Paléontologie française', and was supported by the descriptions of several very characteristic *Onustidæ* under the name of *Trochus*. Since the animals have been made known, and a little more attention paid to the formation of the shells, this classification next to *Trochus* has become the most improbable of all. I shall follow here H. and A. Adams, who place the family after the *Siliquariidæ*, although I confess, that I am not in a position to give a sufficient reason for this arrangement. It is not easy to reconcile oneself to the place, which I have assigned to either of the two last-named families.

Of Gray's classification of the *Phoridæ* (= *Onustidæ*), next to the *Strombidæ* (= *Alata*), Mr. Deshayes simply says, that it is inadmissible. It may be so, but the proof has not yet been given.—We have not accepted Gray's classification of the two last named families as a higher division under the name of Leptopoda, simply because we have no materials to prove it, but we do not wish in the least to pronounce its non-admissibility, or even a great improbability of its correctness. We have, when speaking at length of the family *Alata*, repeatedly drawn attention to the great variety of shells which it includes, and to the probable changes which may be expected in the classification of them.

When we compare the animals of the *Alata* and those of the *Onustidæ*, there is certainly nothing to be said against their close relationship. Of course we must not take two extremely different species, but single organs, as they are subject to variation within the family; for instance, the foot of *Terebellum*, the tentacles and eyes of *Aporrhais*, the long rostrum and slightly expanded mantle of *Struthiolaria*, and others. The operculum of *Xenophora* is by no means so very differently built from the strong and lamellar form of that of many species of *Strombus*; the only difference seems to consist in its position in the aperture, for the somewhat more triangular shape cannot certainly be considered as a distinction of very great importance. I would only in conclusion call attention to those species of the *Onustidæ*, which have a very largely expanded outer lip, to which we scarcely know anything similar, if we ignore its relation to similar expansions in the *Alata*. The great obstacle, which exists to admitting Gray's introduction of the division Leptopoda, is, of course, the old classification of the Siphonostomata and Holostomata, but, although we have retained this ourselves from want of a better one, we have already repeatedly observed, that it cannot remain permanently, and must be replaced by some other. When that has been successfully done, the division Leptopoda of Gray will very probably receive more attention.

H. and A. Adams accept two genera *Onustus*, Humphrey, and *Xenophora*, Fisher (*Phorus*, Montfort).

Mr. Deshayes remarks, that the distinctions could be kept up between the living, but not between the fossil species, and, in rejecting the first name as of no sufficient authority, he retains only the second one. We would not attribute very great importance to the existence or want of an umbilicus, but the thin, anterior margin of the whorls, often provided with hollow spines or tubes, and the concave basis, seem to us useful distinctive characters of *Onustus;* and as these distinctions appear to be supported by some others, in the animal and operculum, the separation into two genera may be regarded as rather convenient. Deslongchamps apparently restricts the name *Onustus* only to those species, which do not accumulate any foreign objects on the exterior of their shells, (vide Bull. Soc. Linn. Norm., Caen, Vol. VI, 1862, p. 147). It is true, that the fossil and recent species of *Onustus* do not accumulate these foreign masses in such great quantities, as usually the *Xenophoræ* do, and that in some fossil species of *Onustus*, no impressions are known on the shell. Still it does not appear probable, that such forms could be generically separated on account of this sole peculiarity. Moreover it would be advisable to compare some of those species with *Infundibulum* and *Galerus* of the *Calyptridæ*, which they very much resemble.

The *Onustidæ* are mostly inhabitants of the eastern tropical seas; they are said to prefer deep waters and stony or gravelly ground to shallow waters. At present there are only about 20 living species known, and about as many tertiary ones. Of cretaceous species there are enumerated by Pictet and Campiche, under the name *Phorus*, (Mat. p. l. Pal. Suisse., 3me. Ser., Foss. Ste. Croix., p. 536), five European and two American. Of the former, *Phorus minutus*, Zek., must be excluded, being only a young specimen of *Astralium radiatum*, Zek., sp. (vide Stoliczka in Sitz. Akad., Wien, 1865, Vol. LII, Revision, etc., p. 59). Binkhorst (Gast. et. Ceph. Limbg., 1861, p. 38, pl. 3, fig. 14), described and figured again the *Xenophora onusta*, (*Trochus id* of Nilson, Hiesinger, Goldfuss and J. Müller). The *Ph. umbilicatus*, Tuomey, is considered by Gabb, in his Synopsis of cretaceous fossils, as doubtful. We have obtained from the uppermost beds of the South Indian cretaceous deposits only one specimen of a new *Xenophora*. The jurassic and liassic deposits of Europe have yielded some ten species, belonging chiefly to *Onustus*. Deslongchamps also described a *Phorus (? Xenophora) Bouchardi*, from the upper devonian beds of the Boulonais, (Bull. Soc. Linn. Norm., Caen, 1862, Vol. VI, p. 151, pl. 8).

LIV. *XENOPHORA*, *Fischer*, 1807.

1.—Xenophora carnatica, *Stoliczka*, Pl. XIX, Fig. 24.

Xenoph. testa trochiformi, late conica; anfractibus circiter septenis, planiusculis, regulariter crescentibus, marginibus anterioribus subcarinatis atque impressionibus corporum alienorum irregulariter instructis, striis spiralibus vix conspicuis sed striis incrementi distinctis notatis; basi ad peripheriam subcarinata, impressionibus irregulariter interrupta, paulo convexa, sublevigata, non umbilicata; apertura quadrangulari, per-obliqua.

Spiral angle 70°; sutural angle 4°.
Height of one whorl : its width (consd. as 1·00) ... 0·27.

A small broadly conical shell, composed of about seven flattened and regularly increasing volutions, the anterior edge of which is sharpened, and more or less irregularly interrupted by the impressions of foreign objects, which are attached to it. The striæ of growth are distinct, but there are very slight traces of a spiral striation perceptible. The basis is almost smooth, and gradually convex towards the centre, which is not umbilicated.

The regularly conical form, the flat volutions with the impressions only on the anterior margin and the convexity of the basis are good characteristics of this shell.

Locality.—Comarapolliam, in lose siliceous sandstone; very rare.

Formation.—Arrialoor group.

XXVIII. *Family,—SOLARIIDÆ.*

Architectonicidæ,* H. and A. Adams' Genera I, p. 241; *Architectomidæ*, Gray, Guide, 1857, p. 62; *Solariidæ*, Chenu, Man. p. 232; *Solariadæ*, Deshayes, An. s. vert. foss. bass. de Paris, II, p. 657.

The animals of the few recent genera of this family have, so far as they have been observed, a moderately expanded foot, adapted for walking; tentacles subulate, thickened, close together at the base, and folded; eyes sessile on the basis or near it externally on thickened bulgings; mantle enclosed, posteriorly with a rudimentary fold; gill cavity divided by a longitudinal fold (?); the proboscis is stated by Gray to be very long, cylindrical, completely retractile, but the existence of teeth on the radula is questioned by the same author. Operculum horny, spiral, flat or conical, consisting of numerous layers.

The shells of the living and fossil species of *Solariidæ are spirally coiled, of a discoidal or broadly conical form, with a large open umbilicus, the edge of which is always more or less angular and generally crenulated; the shell is not pearly† within.*

* *Architectonica* or *Architectoma* of Bolten, as accepted respectively by H. and A. Adams and Gray, can have no claims of priority against such a universally known name, as *Solarium* of Lamarck, which is scarcely later in date of publication.

† We shall refer again to the pearly structure of the shell, when speaking of the new genus *Margaritella*, Meek and Hayden, of the *Trochidæ*.

The relations of the *Solariidæ* to other Prosobranchia are very differently interpreted. Many conchologists still adhere to the old opinion, that they must be classed only as a genus in the family *Trochidæ*; others acknowledge them as an independent group, but still as close in the neighbourhood of the same family.

The principal support for this was said to consist in the form of the shells, although the *non-pearly structure* of the same may be probably of greater importance, than the *form* itself. Since, however, the organisation of the animals in both these families has been made better known, this older classification must be abandoned. Gray has stated, that the proboscis of *Solarium* is long and retractile, the tongue probably unarmed and the tentacles folded, in consideration of which characters he and H. and A. Adams consider the family as closely allied to the *Pyramidellidæ* and *Cerithiopsidæ*. Although this classification cannot be seriously objected* to, specially when the non-existence of lingual teeth may be proved, still it is very difficult to bring the respective shells in close relative connection, without excluding forms which are evidently more correctly referred to the last mentioned two families. We have consequently thought it preferable to treat of the family after the *Siliquariidæ* and *Onustidæ*. The animals do not, of course, exhibit a very great resemblance, because the *Siliquariidæ* have in consequence of their sessile life a rudimentary foot, but as regards the general form of the thickened tentacles, the eyes and the mantle, they do not essentially differ. The form of the foot could be better brought into comparison with that of the *Cæcidæ*. The dentition has, I think, been examined only in one or two species of the *Vermetidæ*, but not in the *Siliquariidæ*; it cannot therefore be quoted as a point of comparison. Quoy and Gaimard (Zool. Astrol. Vol. III, p. 281) were the first who made known the animal of the *Solariidæ*, and placed *Solarium* in the neighbourhood of *Vermetus*, although they state that, from what they know of the animal, it does not change the generally accepted idea of the classification of the genus with *Trochus* in the same family. There are, however, several points in organisation, which support the classing of the *Solariidæ* in the place, assigned to them (perhaps accidentally) by the two authors of the Zoology of the Astrolabe.

The operculum of *Torinia* is in every way similarly formed to that of *Siliquaria*; it could scarcely be compared with that of any other genus of the Prosobranchia. The operculum of *Solarium* proper very much recalls, on the other hand, that of the *cerithiinæ*. The usually crenulated edge round the umbilicus, terminating at the aperture with a slight insinuation, appears to indicate at least some kind of analogy with the slit of the *Siliquariidæ*. A few fossil species of the genera *Eccyliomphalus*, *Bifrontia*, and others, exhibit, in the total or partial dissolution of the whorls, a very close resemblance to the *Siliquariidæ*, *Vermetidæ* and *Cæcidæ*, which may also be brought in support of the classification of the *Solariidæ* in this place.

* Vide general notes on the Holostomata, p. 205.

There is a good deal to be said as regards the genera, which should be admitted into this family, although this subject has been lately admirably treated by Deshayes in his new edition of the Paris fossils. This conchologist quotes four genera only, namely, *Solarium*, *Discohelix*, *Bifrontia*, and *Euomphalus*. We think, however, that the varieties of shells seem to make a larger number, and some alterations in the nomenclature, of the genera necessary. Not being, however, in possession of all the desirable materials, which would be required to make such alterations really of any good service, we must confine ourselves to a few remarks, which, we trust, will at least lead a step further towards clearing up the confusion at present existing among the genera of this family. The recent *Solaria* of Lamarck have been divided by H. and A. Adams into three genera. The number of fossil species of the *Solariidæ* is very large, and the following may at present serve as a short review of the different generic forms belonging to this family.

1. *Solarium*, Lamarck, 1799, as restricted for the depressed, sub-conical forms, possessing a flat, pucispiral operculum.

1*a*. *Philippia*, Gray, 1840, differs from *Solarium* only by its smooth shell. Gray places the genus in the *Trochidæ*, but if the shell is not pearly within, H. and A. Adams' classification is preferable, at least until the animal is better known, for mere exterior resemblance does not necessarily imply an absolute affinity with that of *Trochus*.

1*b*. *Torinia*, Gray, 1840; the shell does not differ from that of *Solarium*, but the operculum is conically elevated and composed of numerous volutions.

Although there is no particular difficulty felt in accommodating the comparatively few living species to these three divisions, it is really impossible to do the same with the fossil shells, and we can only very cautiously apply such a division to them. *Torinia* was dismembered from *Solarium* upon the examination of not more than two or three species with the animals and the opercula, and, it is possible, that many other similar variations of the opercula may be found among those species, to which the name *Solarium* has been restricted. Deshayes (loc. cit., p. 664,) arranges the eocene *Solaria* of the Paris basin in four sub-generic divisions: *Solarium*, Lamck., as restricted; *Torinia*, Gray; *Disculus*, Desh.; *Philippia*, Gray. I do not think, however, that any of these divisions can aid very much in the determination of the shells only. The *Solarium disculus*, Desh., which is apparently considered as the type of the section *Disculus*, would seem rather to agree with *Philippia;* and again species, like *Sol. gratum* or *Sol. discretum*, Desh., referred to the section *Philippia*, do not correspond at all with that genus, as proposed by Gray, but rather with *Torinia*. Any one after comparing the large number of specimens of our *Solarium Coothoorense*, would soon be at a loss, what to call a *Torinia* and what a *Solarium;* and again in examining a similar number of *Solarium Olapaudiense* the same difficulty arises as regards *Disculus* and *Philippia*. It is evident, that we have not yet discovered the proper characters of distinction, but it is still possible, that it may result from the study of the recent shells, and then be made of better practical use in our palæontological researches.

Species, which have to be referred to *Solarium*, begin in the Trias,* and gradually increase to the tertiary period, when they seem to have reached their maximum of development; for there are not more than 50 recent species known, and these live principally in tropical waters.

Pictet, in his review of the cretaceous species of *Solarium* (Mat. Pal. Suisse, Foss. Ste. Croix. 3me. Ser., pp. 550-555)† quotes forty species, among which, however, several alterations must be made. The surface of the shell, upon the ornamentation of which so many new species had been founded, is extremely variable in different stages of preservation. Still more doubt must be entertained about those species, which are determined merely from casts. In my revision of the Gosau-Gastropoda (Sitz. Akad., Wien, 1865, Vol. LII, p. 61), I have noticed, that the three species, described by Zekeli as *Sol. quadratum, d'Orbignyi,* and *textile,* belong to the same species, formerly described by Sowerby as *Sol. quadratum.* Some similar alterations, we presume from this, may be expected among other known species.

Binkhorst described from the Maestricht-chalk since the publication of Pictet's list (Gast. et Ceph. craie., Limbg., 1861, p. 37, pl. 3, figs. 11 and 12) *Sol. cordatum* and (ibid. p. 77, p. 5^{a3}, fig. 10) *Sol. Kunraedtense.* The first is a true *Solarium*, but the second could only be retained, if the shell were not pearly within, otherwise it more resembles *Margaritella,* and other *Trochidæ.* Baily describes (Ann. Mag., 1860, Vol. VI, p. 28, pl. 1, fig. 2,) a very fine species from the Upper Greensand near Dorchester under the name of *S. Binghami.* Guembel (Geog. Beschreibg. d. Bayer. Alpengeb., 1861, p. 573) named a species *Sol. stellatum.* Another species was lately figured by Guéranger as *Sol. Michelini,* (Album pal. de la Sarthe, 1867, pl. 10, fig. 21), previously named in his 'Essay, etc.,' 1853.

Two species have been described from Africa, namely, *Sol. Bailyi,* Gabb (Am. Phil. Soc., 1861, Vol. VIII, p. 95—*Sol. pulchellum,* Baily, Quart. Journ. Geol. Soc., Lond., 1855, XI, p. 457, pl. 12, fig. 3, non *idem* d'Orbigny), and *Sol. Vattoni,* Coquand (Géol. et Paléont., Prov. Const., 1862, p. 182, pl. 4, figs. 7-9).

To the American *Sol. Abyssine,* Gabb, the same author lately added in the Pal. of California 1864, Vol. I, p. 116, etc., four species, under the generic name of *Architectonica,* namely, *Sol. Veatchii, cognatum, Hornii,* and *inornatum.* The *Sol. flexui-striatum,* E. and Shum. (Meek and Hayden) forms the type of the genus *Margaritella* and belongs to the *Trochidæ,* because it has the internal shell pearly.

From India a species of *Trochidæ* was described by d'Orbigny (Pal. Astrol. pl. 4, figs. 9-11) as *Sol. deperditum,* which must be again excluded, but in its place we shall describe four new species, *Sol. Arcotense, Kurribiemse, Coothoorense,* and *Vylapaudense,* which all belong to the uppermost beds of our cretaceous deposits; the two last-named species being rather common shells.

1*c*. *Solariorbis.*—I find this name in Conrad's Check lists of eocene and oligocene fossils, p. 13-14. There are four species mentioned, three of which were described by Lea in his contributions to Geology as *Delphinula, Planaria,* and *Turbo.* I really do not understand what the distinctive characters‡ of the genus may be, for Lea's determinations do not seem to be in the least contradictory to his figures, and rather detailed descriptions.

2. *Discohelix*, Dunker, 1848, (*Orbis*, Lea§ not Lacp., Blain. a. o.; *Omalaxis*, apud H. and A. Adams and Gray; *Bifrontia*, apud Chenu). This genus was

* Laube in Sitzgb. Akad., Wien, 1866, Vol. LIII, Fauna der Schichten von St. Cassian, etc., quotes a *Solarium planum.*

† See also Gabbs' Catalogue of cret. fossils in Proc. Am. Phil. Soc., 1861, VIII, p. 136.

‡ Conrad refers for the characteristics of the new species to the first Vol. of Am. Journal of Conchology, which we have not yet been able to obtain.

§ Lea Contributions to Geol., 1833, p. 123, pl. 4., fig. 112.

proposed for a liassic *discoidal shell, composed of quadrangular whorls, carinated and more or less crenulated on the upper and lower edges of the back, on which the striæ of growth are insinuated backwards.* In my paper on the Gastropoda and Acephala of the Hierlatz-strata (Sitzb. Akad., Wien, 1860, Vol. XLIII, pp. 180, etc.), I have described several liassic species, and at the same time I have endeavoured to prove, that the peculiarities of these shells entitle them to be classed under a genus, distinct from *Straparolus*, (*Euomphalus*, olim). Farther details may be found in that paper. The oldest forms very much resemble *Straparolus* in being above slightly elevated or plane, like *Straparolus tuberculosus*, d'Orb., but they strictly retain the angular form of the whorls with an obtuse back and the two marginal keels, the lower of which corresponds with the umbilical, and the upper with the peripherical edges of *Solarium*. Only in this way is it possible to make a correct comparison between the two genera.

Species, which correspond in all the above mentioned characters with *Discohelix*, already begin in the Silurian deposits, and seem to be most numerously represented in the Lias. They gradually decline in number from that time. I am not aware of a single species, which has been described from the cretaceous rocks of Europe, nor have I anything to contribute from India. The two species, *Straparolus subplanus*, Gabb, and *St. lapidosus*, Morton, sp. (*Delphinula* idem) from the Alabama cretaceous deposits may, however, possibly belong to *Discohelix* (Journ. Acad. Nat. Sc., Phil., 2nd Ser., Vol. IV, pp. 299-300, pl. 48, figs. 4 and 5). The former seems to have had the last volution partially detached from the rest, a case which is commonly found among the eocene *Bifrontiæ*. Tertiary species appear to be equally rare. The *Orbis rotella*, Lea (Cont., p. 123) is a true *Discohelix*. Michelotti's *Bifrontia Rochettina*, (Descr. Foss. Terr. mioc. de l' Italie sept. 1847, p. 172) is stated to be a discoid shell, with two slightly crenulated keels above and below on the periphery of the last whorl and a quadrangular aperture; these characters evidently recall the form of a *Discohelix*.

The operculum of the *Discoh. zanclea*, Phil. sp., is conically elevated, composed of numerous volutions; it resembles that of the *Torinia*-group of *Solarium*, and of the *Siliquariidæ*. We are indebted to Deshayes (loc. cit., pp. 678, &c.,) for having pointed out the mistakes, into which H. and A. Adams, Gray and other subsequent authors, had fallen, when they declared Philippi's living* species, *Bifrontia (Discohelix) zanclea*, which he only doubtfully referred to *Bifrontia*, to be identical with that genus. Deshayes says, that one has first to examine the fossil species of *Bifrontia*, to be certain of the distinctions, which exist between them and the *Discoh. zanclea*, Phil. sp. In fact the growth of the shell appears to be a totally different one. Let us take for comparison one of the species, which are otherwise closely allied to *Discohelix*, as, for instance, the *Bif. amonoides*, Desh., we can always notice that the striæ of growth are in *Discohelix* insinuated *backwards*, while in *Bifrontia* they are always curved *forward*.

Another living species, the *Delphinula (Liotia) evoluta*, Reeve, for which H. and A. Adams proposed the sub-generic name *Ilaira*, (Gen. I, p. 405,) may also be considered as a *Discohelix*. The shell is perfectly identical with the typical, liassic discoidal forms, *Discohelix orbis*, Reuss, sp., and other species.

Hörnes (Denksch. Akad., Wien., 1855, pt. II, p. 42, pl. 1, fig. 6), when introducing his new genus *Platystoma* (not *idem*, Klein, 1753, and not to be confounded with *Platyostoma*, Conrad, Hall), draws attention to several species, which we have referred to *Discohelix*, being probably incomplete specimens of the same genus, as

* H. and A. Adams (Gen. I, p. 244,) state, that living specimens of this species have been dredged off the coast of Madeira by MacAndrew.

his triassic *Platystoma Suessi.* This remarkable shell,—which must receive a new generic name,—is, in incomplete specimens, hardly to be distinguished from *Discohelix*, but in reality *the outer lip was expanded into a large irregular wing, and the apertural margins were united and circular, the aperture itself being suddenly deflexed, so as to have its plane parallel to the discoidal form of the shell.* It cannot be denied, that some of the species of *Discohelix* may be shown to belong to the same genus as the *Platystoma Suessi,* Hörnes, but there are already several cases known, where the aperture of *Discohelix* has been observed, so as fully to guarantee its generic independence. It would besides be hardly advisable to suppose, that all the numerous species of known *Discohelix* are only immature specimens. The small size of the triassic shell would give little support to such an idea. It is difficult to say anything about the classification of the *Plat. Suessi,* as the form of the aperture excludes it from this family. I am not acquainted with any other form, to which the expansion of the outer lip could be even remotely compared, than to that of some species of *Onustus* and *Cirsotrema.*

3. *Cyclogyra*, Wood, 1842 (Ann. Mag. Nat. Hist., Vol. IX, p. 458, pl. 5, fig. 5),—*Planaria*, Brown, not Linn. and others,—*Discohelix*, apud H. and A. Adams, Chenu and others.

Wood proposed this genus for a small, *orbicular, discoidal, and smooth shell, composed of numerous depressed volutions, being rounded at the periphery, and each succeeding one embracing partially the previous.* It seems to us, that this genus ought to be retained in this very same sense, as originally proposed for the little shells named *Planaria* by Brown and other species, like the recent *Orbis foliaceus* of Philippi. Lea described several tertiary species from the Alabama eocene deposits, and others are reported in different works. I must here again refer to the fossil *Cornuspiræ*, for I believe many described as such are not Foraminifera, but Gastropoda.

Wood, when instituting the genus, says, that it may belong to the *Vermetidæ,* which classification is not at all improbable. I do not know the details of the organisation of *Orbis foliaceus,* Phil., but it is certain, that the form of the shell very much recalls some species of *Burtinella,* and possibly the genus may be better placed in the *Vermetidæ.*

The only cretaceous species, which I think is a true *Cyclogyra,* is the *Cycl. (Discohelix) Leana,* Gabb (Pal. Calif. 1864, I, p. 119, pl. 20, fig. 75,) from the cretaceous Californian deposits.

4. *Ophileta*, Vanuxem, 1842, (Hall. Pal., New York, I, p. 11, pl. 3, figs. 4-6) has been proposed for a few *discoidal smooth shells, composed of very numerous whorls.* It is quite impossible to regard this characteristic as of any importance for the present. The two palæozoic species, *O. levata* and *complanata,* which had been described only from very imperfect specimens, are in fact nothing more than discoidal *Straparolus* or *Discohelix*; the first named has the whorls keeled only below, the second apparently on both margins of the periphery, above and below. The striæ of growth have not been observed.

5. *Eccyliomphalus,* Portlock, 1843, (Geol. Rep., etc., p. 411,—*Serpularia,* Römer, 1843, *non* Münst.) has the *whorls generally coiled in one plane, or nearly so, and dissolute,* as in an *Ancyloceras.* The striæ of growth are not perceptibly bent

and the aperture was probably simply rounded without any insinuations. This genus evidently exhibits, as regards the form of the shell, the greatest relation to the *Vermetidæ* and *Siliquariidæ*. The few species known are palæozoic.

6. *Straparolus*, Montfort, 1810; *(Euomphalus*, Sowerby, 1812, or 1814), and

7. *Bifrontia*,* Desh., 1833 (Anm. s. vert. Foss. Paris, 1. ed., pt. II, p. 221; 2me. edit., Vol. II, p. 677).

a. There could scarcely be greater difficulties to overcome in the classification of the old genus *Helix*, than are met with in that of the shells, known to palæontologists under the above two or three names. No two publications are to be found, which agree in the signification of these names and the limits of the genera or groups of shells, to which they ought to refer. It cannot be questioned, that the name *Straparolus* of Montfort has priority before that of *Euomphalus*, though the latter has been applied to different species, but the former was certainly not unknown, even if unjustly neglected like many other names of the same author. When we compare a series of specimens of the well known *Strap. (Euomphalus) Dionysii* or *pentangulatus* and others, we can observe, that the striæ of growth are on, or near the upper keel, distinctly insinuated backwards, and on the periphery bent in the same degree forwards. In other specimens of these very same species both the sinuations are much less expressed, and again in others the striæ cross the shell, above and below, almost without any alteration in their course. If there are any keels present on the surface of the shell, they necessarily involve some kind of change in the direction of the striæ. These keels are usually sharper in young specimens, and often altogether disappear on the last whorl, or in general when they approach the margins of the aperture.

Supposing, we consider the animal of *Strap. pentangulatus* similar in form to that of the living *Solaria*, we have then to look upon the insinuation near the suture as being produced by the neck of the animal, and the prolongation of the outer margin of the aperture by the outer edge of the mantle. When the animal has been accustomed, or obliged by circumstances, to carry its shell in a more elevated position, which it probably did as long as the shell was of small size, the insinuation corresponding to the neck, was made deeper, and certain edges or sinuations of the mantle, producing the keels, were bent more externally, and consequently these keels were formed more sharply. At the same time, however, when the insinuation at the neck was deeper, the peripherical edge adjoining it must have become more projecting. Subsequently, when the animal with its shell grew to a larger size, it would seem, that its movements became more difficult or less active; the shell, not being so often lifted up and down, was, moreover, carried in a more or less horizontal position, the consequence of which would be, that the keels and any other insinuations would in the same proportion become less developed.

* The names *Omalaxe, Omalaxon, Omalaxis* had scarcely been known, when Deshayes substituted for them *Bifrontia*; they ought not to be revived again, so as to increase the already existing great confusion. They actually never became the property of science, except in a totally misunderstood sense, as commented on by Gray or H. and A. Adams.

Only by some such suppositions are we able to explain the variations noted above, which indeed not unusually occur in the process of growth of one and the same species.

It has been proposed by several conchologists to unite the genera *Straparolus (Euomphalus)* and *Solarium* in one. When, however, we compare the large number of species of both these genera, it appears, that *the smooth or at least less ornamented surface of the shell, the constant want of a distinctly crenulated margin round the umbilicus, combined with the roundish form of the whorls of Straparolus*, makes its separation from *Solarium* very desirable. Of many of the palæozoic *Straparoli* the opercula* are known, and they very much resemble those of *Torinia*, being thick and composed of numerous lamellar volutions.

Maclurea, Emmons, or *Maclurites*, Lessueur, can scarcely be separated from the smooth palæozoic *Straparoli*. The same is the case with *Schizostoma*, Brown, of which the author calls *Strap. (Euomphalus) catillus*, Sow., the type. It is a discoid form, which no doubt unites several characters of *Discohelix* with those of *Straparolus*, but as the striæ of growth are not bent backwards on the periphery, it ought to remain in the latter genus. Römer, in the third edition of Bronn's Leth. geognostica, Vol. I, p. 456, gives up the name *Schizostoma*, and again places the above-mentioned species in *Euomphalus*. Deshayes, (Anim. s. vert. Foss., Paris, 2nd edit., Vol. II, p. 678,) seems,—for some particular reason, which he does not specify,—inclined to retain *Schizostoma*, but he states at the same time, that he examined a complete specimen of *Strap. catillus*, which exhibited scarcely any characters different from his *Bifrontia!* We shall immediately enter into the characters of this genus, and state in which sense it may be retained. It is not likely, that *St. catillus* is a *Bifrontia*, nor yet the two species, lately added by Deshayes to this genus, *Bif. ammonoides* and *Deshayesi*.

From what we have above stated regarding the characters of *Straparolus*, it is evident, that *Platychisma*, Conrad, cannot be, strictly speaking, looked upon as anything else than a smooth *Straparolus* with a smaller umbilicus and somewhat flattened volutions, but on account of the different form of these, it may be considered as a subgeneric division.

The largest number of *Straparolus (Euomphalus*, olim.), occur in palæozoic strata, becoming gradually less numerous in the subsequent formations. Of living species we actually know nothing. The cretaceous species will amount to about ten. Pictet (Mat. Pal. Suisse., 3me. Ser., p. 557), after having suggested the separation of *Solarium* and *Straparolus*, quotes of the latter six European species, of which two, *Strap. Michaillensis*, P. and Camp., and *St. Moutonianus*, D'Orb., are ornamented with strong transverse ribs. Very similar forms are known as *Delphinula* and *Liotia*, and it is doubtful, whether they do not more correctly belong to those groups of shells. Prof. Reuss named a species from the Gosau formation, *Euomphalus canaliculatus*, (Denksch. Akad., Wien, 1854, Vol. VII, p. 149, pl. 29, fig. 7). He speaks of a sharp keel on the edge of the umbilicus, and as the shell resembles in every other respect *Solarium*, it requires rather better materials to prove, that the species is really a *Straparolus*. I never met with the species myself.

* I had lately the opportunity of examining some very fine specimens of these in Mr. Barrande's extensive collections at Prag.

Gabb (Pal. Calif., 1864, I, p. 120) lately described two new species, *St. paucivolvus* and *lens*, of which the second approaches rather more to *Discohelix*, but in neither of them have the striæ of growth been observed. Meek (Smith. Misc. Coll., No. 177, 1864, Check list of crét. foss., p. 18) mentions two doubtful species from Alabama, *Strap. lapidosus* and *sub-planus* of Gabb.

We have to add one species from South India, *Strap. indicus*, n. sp., a smooth, discoid shell with the striæ bent distinctly forward on the outer periphery.

b. The genus *Bifrontia* ought to be accepted in the sense proposed by Deshayes in the first edition of the Paris fossils. The principal characters consist in the *discoidal form, in the angular shape of the whorls, the last of which is often partially or wholly uncoiled from the others, in the narrow emargination near the suture, in the crenulations of the umbilical edge, and in a broad insinuation of the basal portion of the outer lip.*

The two species, lately added by Deshayes, *Bif. ammonoides* and *Deshayesi*, may better be transferred to *Straparolus*, especially on account of the want of the crenulated edges of the umbilicus, and on account of the outer lip being produced in the middle or on the periphery of the whorls, not above as in typical *Bifrontiæ*. We had no occasion to examine any of the characteristic species of *Bifrontia* described by Deshayes, but if the two last mentioned species cannot be separated from the others, the entire genus *Bifrontia* must be abandoned, because it would be impossible to give any distinctions from *Straparolus*.

Beside the eocene species of *Bifrontia* there was also one miocene species referred to this genus by Michelotti. We have, however, already remarked, that this one probably belongs to *Discohelix* (vide p. 251).

LV. SOLARIUM,—*Lamarck*, 1799.

1. Solarium arcotense, *Stoliczka*, Pl. XIX, Fig. 29.

Sol. testa orbiculata, spira paulo-elevata; anfractibus quadrangulatis, ad peripheriam obtuse carinatis, in superficie striatis: supra duabus striis spiralibus prope suturam positis, una prope peripheriam, ceteris fere æqualibus ornatis; striis incrementi supra valde arcuatis, infra prope rectis; umbilico latissimo, ad marginem carinato atque crenulato; apertura quadrangulari, ad marginem columellarem angustata.

A small almost discoidal shell, being slightly convex above and largely umbilicated below. The whorls are numerous, obtusely angulated at the periphery and crenulated on the edge of the umbilicus. The entire surface is spirally striated. Of the spiral striæ two near the suture, and one towards the periphery, are considerably stronger than the rest. The striæ of growth are distinctly curved S-form above, but nearly straight below. The aperture is oblique and angular, being less high on the columellar margin, than at the periphery. I am not acquainted with any similar species from cretaceous beds, but there are some such largely umbilicated forms known from the tertiaries, like *Sol. millegranum*, Lamk.

Locality.—Ninnyoor, in white, soft, calcareous beds; very rare.

Formation.—Arrialoor group.

2. Solarium kurribiemse, *Stolizcka*, Pl. XIX, Fig. 30.

Sol. testa orbiculata, late conica, apice obtusa, infra late umbilicata; anfractibus supernis planulatis, ad suturam acute crenulato-carinatis, ultimo ad peripheriam bicarinato; carina superna fortiori, utraque spinulose crenulata; basi valde convexa, in margine umbilici acute carinata, atque irregulariter crenata seu subtuberculata; superficie spiraliter atque transversaliter striata; apertura intus, subrotundata, extus fere quadrangulari, ad peripheriam blangulata.

This is the second known cretaceous species with two peripherical keels on the last whorl, the first having been described from the upper Gault of Ste. Croix by Pictet and Roux, and subsequently by Pictet and Campiche as *Sol. Tollotianum* (Pal. Suisse 3me. Ser., p. 541, pl. 88, figs. 6 and 8). Although these two species would at first sight appear to be the same, they cannot be identified from the figure given by Pictet and Campiche: the distinctions of our Indian fossil being a more depressed form, so as to make on the upper whorls only the stronger keel visible at the suture, and the want of a third basal keel. There is a little discrepancy between Pictet and Campiche's description and figure (loc. cit., p. 542, pl. 88, fig. 6a). The former says, that the basal keel encircles the umbilicus, but in the latter this keel is placed about the middle of the basis, and originates at the posterior angle of the aperture, it cannot, therefore, be regarded exactly as the edge of the umbilicus. Beside these differences the figure of *Sol. Tollotianum* shows posteriorly a slight keel along the suture of each whorl, and the other keels are more strongly tuberculated, while in our specimen they are provided with short spines. The spiral and transversal striation, the size of the umbilicus, and the general form of the whorls are in both species quite the same.

Locality.—Kurribiem, in a light-brown, coarse, siliceous sandstone; very rare.

Formation.—Arrialoor group; the locality is on the boundary between the Arrialoor and the Trichinopoly groups, but the mineralogical character of the rock rather more reminds one of the siliceous and sandy beds of the uppermost of the three divisions.

3. Solarium karapaudiense, *Stoliczka*, Pl. XX, Figs. 1-4.

Sol. testa depresso-conica, spira plus minusve elevata; anfractibus ad peripheriam obtuse carinatis, supra prope suturam applanatis, postea sub-angulatis atque infra angulum abrupte seu lente declivis; superficie spiraliter atque transversaliter striata: una stria spirali infra medium posita sæpissime ceteris fortiori; umbilico moderato, ad marginem crenulato; apertura angulari, marginibus tenuibus instructa.

Spiral angle 75°-110°.

Shell broadly conical, with more or less elevated spire, according to which the degree of the spiral angle differs. All the whorls are flattened along the posterior suture, bounded by a sharp angle, after which the whorls slope rapidly, or more or less gently, towards the periphery, according to the greater or lesser elevation of

the spire. The surface is spirally and transversally striated. On the flat sutural portion there are sometimes present only two or three elevated spiral lines, but the transverse striæ are generally stronger here, than on the rest of the shell. Below the angle there is, about the middle, one line prominently stronger than the others. Along the anterior margin there is always a keel present, being on the periphery of the last whorl specially distinct, but always obtuse or rather turned upwards, so as uniformly to curve on the base. The latter is convex, and the spiral striæ near the periphery are somewhat stronger than those, which are placed nearer to the centre. Very seldom, and only in very young specimens, are all the spiral striæ of the shell nearly equal, but in this case they are very fine, (see Fig. 4, Pl. XX). The umbilicus is crenulated on the edge, and its width measures about one-third of the basal diameter. The aperture is almost quadrangular, with very thin margins.

Our species is closely related to *Sol. moniliferum*,* Michelin (not *Sol. moniliferum*, Brown)†, but it wants the posterior tuberculated edge and the strong anterior keel on the whorls, which are so characteristic for Michelin's species.

Localities.—Karapaudy, S. of Arrialoor, Comarapolliam, and near Veraghoor; in coarse, siliceous sandstone; common.

Formation.—Arrialoor group; the last named locality is on the boundary between this and the Trichinopoly group.

4. Solarium vylapaudiense, *Stoliczka*, Pl. XX, Figs. 5-6.

Sol. testa orbiculata, seu depresso conica; anfractibus in junioribus speciminibus ad margines posteriores paulo contractis atque spiraliter minutissime striatis, in adultis fere planis levigatisque, ultimo ad peripheriam acute angulato, ad basim convexiusculo, spiraliter atque transversaliter striato: striis transversalibus ad marginem umbilici multo fortioribus; umbilico angustato, margine crenato; apertura obliqua, subquadrata.

Spiral angle 105°- 120°.

The form of the shell varies from a broadly conical to an almost discoidal shape. In young specimens the whorls are somewhat constricted posteriorly, and very finely spirally striated; in older specimens they are almost perfectly flat, separated by impressed sutures and smooth. The last volution is angular at the periphery and convex at the basis, which is provided with a fine spiral and transverse striation; these striæ being much stronger round the umbilical edge, on which they produce a slight crenulation. The spiral striation becomes very often obsolete, at least towards the peripherical margin. The umbilicus is of moderate size, its width being about one-fourth of the total diameter of the basis; aperture quadrangular and oblique.

* D'Orbigny, Pal. Franç. terr. crét., II, p. 197, pl. 179, figs. 8-12.

† *S. submoniliferum*, D'Orb., Prod. III, p. 45.

This species, having an almost smooth shell and a narrow umbilicus, belongs to that section of *Solarium*, for which Deshayes proposed the name *Disculus*, but there is evidently no reason for such a sectional distinction, and certainly not for the introduction of names, equivalent to generic denominations, unless we adopt the trinominal system, wherever it appears to be practicable. The *Sol. Hugianum*, Pict. et Roux (Pal. Suisse, 3me. Ser., p. 540, pl. 88, figs. 3-5,) differs from our species by its more conical form, anteriorly carinated whorls, an apparently much stronger ornamentation on the basis, and a somewhat larger umbilicus. When compared with *Sol. Karapaudiense*, it is readily distinguished by its sharp and angular periphery, while in the former the peripherical keel has the appearance of having been turned upwards. The largest specimen of *Sol. Vylapaudiense* measures 30mm. on the basal diameter, those of *Sol. Karapaudiense* only 20mm.

Localities.—Vylapaudy, Olapaudy, and near Arrialoor, in light coloured or yellowish sandstone; rather common.

Formation.—Arrialoor group.

LVI. STRAPAROLUS, *Montfort*, 1810. (Vide p. 253).

1. Straparolus indicus, *Stolizcka*, Pl. XX, Fig. 7.

Strap. testa discoidea, in utroque latere æqualiter excavata; anfractibus numerosissimis, angustis, levigatis, ultimo supra infraque obtuse angulato, ad peripheriam convexo; striis incrementi minutissimis sed distinctis, extus ad medium anticé valde productis, supra atque infra falcatis; sectione anfractuum semilunari.

Width of one whorl, above, : diameter of shell (considered as 1·00) ... 0·18.
„ „ „ „ „ : its height ... („ „ „) ... 0·38.

We have only been able to examine a fragment of this species, but the impressions of nearly all the whorls leave no doubt as to the above mentioned characters. The shell is symmetrically planorboid, consisting of remarkably numerous and very narrow volutions. The surface is smooth with the exception of the striæ of growth, which are bent above and below in S-form, and strongly forward on the back. The species evidently approaches in form the eocene *Bifrontia ammonoides*, Desh., which, as already stated, should most probably be referred to *Straparolus*. We do not know any cretaceous species which we could compare with the Indian fossil, for the *Discohelix (Cyclogyra) Leana*, Gabb, has the whorls much more depressed; and there are no other smooth, cretaceous *Straparoli* known, which are symmetrically concave on both sides.

Locality.—N. E. of Odium, in a yellowish calcareous sandstone.

Formation.—Ootatoor group.

XXIX. *Family,—PLANAXIDÆ.*

(Sub-families,—PLANAXINÆ and *LITIOPINÆ).*

H. and A. Adams' Genera, I, p. 321; Gray's Guide, 1857, p. 95; Chenu's Manuel, *LITORINIDÆ* in parte, p. 303.

Judging from the accounts given by H. and A. Adams and Gray of the position and form of the gills and of the existence of a distinct siphonal fold, the separation of these shells from those of the *LITORINIDÆ* appears justifiable, although the animals and shells of both of them are in many other respects very much alike. On account of this similarity we would prefer to range the *PLANAXIDÆ* in this place, rather than after the *CERITHIIDÆ*, to which some authors have referred the genus *Planaxis*.

The family could be divided conveniently into two sub-families, *PLANAXINÆ* and *LITIOPINÆ*, with the genera *Planaxis* and *Litiopa* as the respective types. The species belonging to the *LITIOPINÆ* are mostly thin shells, and in the same sub-family have to be classed all the species of *Alaba*, which A. Adams separates into three sub-generic groups, *Alaba*, *Diala*, and *Styliferina* (vide Ann. Mag. Nat. Hist., 1862, X, p. 294).

Although the species of *LITORINIDÆ* and similar forms already begin in the Silurian beds, there are no certain remains of the *PLANAXIDÆ* as yet known below the tertiary strata, and even from these only very few have been reported.

XXX. *Family,—LITORINIDÆ.*

H. and A. Adams' Genera, I, p. 312; Gray's Guide, 1857, p. 86, and *LACUNIDÆ*, p. 92; Deshayes, Anim. s. vert., Foss. de Paris, 2me. edit., Vol. II, p. 355.

The animals of the *LITORINIDÆ* have a moderately expanded foot, adapted for walking or sliding on rocks; the mantle is generally enclosed with an entire edge, or occasionally with a rudimentary siphonal fold in front. The rostrum is produced, wrinkled, and not retractile; jaws horny; lingual ribbon with one central and three lateral teeth on each side; tentacles lengthened, subulate, far apart on the head, with eyes sessile, or on small bulgings near their outer base, or situated within the length of the tentacles; usually without neck-lobes or lateral cirrhi; operculigerous lobe simple, seldom provided with appendages, or perceptibly expanded. The gills are very large, formed of numerous flat, free plates and occupying nearly the whole surface of the branchial cavity. The pectinations of the branchial plume of some *LITORINIDÆ* are, however, stated to be so fine and slender, as to be occasionally scarcely noticeable. Gray calls them, therefore, PSEUDOPNEUMA, adding the *TRUNCATELLIDÆ* to them. It seems in fact, that the division of the branchial plume into numerous pectinations precedes the total disappearance of the gills, for the branchial plumes seem to become gradually more slender and finer in those animals, which are found in places high above the low tide mark. Several species thus seem actually

for weeks together to live only in the moist air on the sea coasts,* and in these species the gills are said to be very rudimentary. A few species live in fresh or brackish waters.

Operculum horny, multispiral, with nearly central nucleus; or pucispiral, with a lateral or subterminal nucleus.

Shell spiral, conical, with more or less turbinate or depressed spire; aperture ovate, anteriorly entire or obsoletely effuse, internally never pearly.

The number of genera, which are admitted by different authors in this family, is very variable. Having adopted Gray's and H. and A. Adams' views as regards the family *Planaxidæ*, we would in a similar manner suggest a division of the *Littorinidæ* into the three sub-families, *fossarinæ*, *lacuninæ* and *littorininæ*.

a. *Sub-family,—FOSSARINÆ.*

Shell solid, spire depressed or short, last whorl ventricose, columella usually hollowed out; aperture anteriorly sub-effuse; surface ornamented with spiral and transverse ribbings or striæ.

This group may include the following genera :—

1. *Risella*, Gray, 1840, showing by its broad, conical form great relation to the *Solariidæ*.

2. *Fossar*,† Gray, 1840, (Syn. Brit. Foss.;—H. and A. Adams' Genera, I, p. 319); this genus has been separated by Recluz (Jour. Conch., XII, p. 247) into two. For those species, which have the mantle margin entire and a kind of veil between the two tentacles, the name Fossar has been retained, while the name

3. *Clathrella*, Recluz, 1864, has been proposed for those species, which have the margin of the mantle crenulated, but not possessing a veil between the tentacles. The shells of both these genera are very similar.

4. *Fossarina*, Adams and Angas, 1863, (Proc. Zool. Soc., p. 423); the type is *Fossar variegatus*, Ad.

5. *Isapis*, H. and A. Adams, 1854, (Gen. I, p. 320). The shell is distinguished from *Fossar* by a central tooth on the inner lip, resembling that of *Naticodon* of Ryckholt (Fam. *Neritopsidæ*).

6. *Conradia*, A. Adams, 1860, (Ann. Mag. Nat. Hist., V, p. 409), a genus somewhat intermediate between *Trichotropis* and *Fossar*; it much recalls the fossil *Purpurina*. A. Adams (Proc. Zool. Soc., 1863, p. 110) proposes in this genus two sub-genera, *Gottoina* and *Cithna*; the shells are from the Japan seas.

* Of many of the species of *Littorina* a large number of specimens can often be found together, attached to rocks above the usual high water mark, where they are hardly springled with water once in a few days. They are generally, for the greater part of the day, exposed to the powerful rays of a tropical sun, but they attach the aperture of the shell so perfectly air-tight to the rock, that hardly any evaporation of the water can take place, and consequently their gills are kept moist.

† It is true that the name '*le Fossar*' was at first used by Adanson in his Hist. etc. du Senegal, 1757, p. 173, but it was used by this author only as a specific distinction in the Genus *Natica*; it was therefore *not a generic* name, and Gray was perfectly correct when he used it first in this sense. I do not see what great barbarism there is in this name! Any one may take the liberty of saying the same of *Fossarus* of Philippi, and change it into *Fossarius*. Such changes of generic names, unless they are evident misprints, cannot be admitted.

7. *Couthouyia*, A. Adams, 1860, (Ann. Mag. Nat. Hist., V, p. 410), is another similar form, founded also upon a Japanese shell. A. Adams (loc. cit., p. 410,) says, that the three last named genera, and some others belonging to this sub-family, ought to be united in a distinct family under the name of *Fossaridæ*.

The *Natica carinata*, Sow., (Trans. Geol. Soc., Lond., IV, 1836, p. 241, pl. 18, fig. 8), may belong to the *fossarinæ*, because it has a thick shell and strong spiral ribs, like many species of this sub-family. We do not know any other cretaceous species, than the doubtful *Fossar? Nebrascensis*, Meek and Hayden, quoted in Proc. Acad., Phil., 1860, p. 423.

b. *Sub-family,—LACUNINÆ.*

Shells solid, depressed, conical or globular, last whorl ventricose, much larger than the previous ones; aperture occasionally effuse (more so in fossil species); inner lip flattened and expanded at the termination of the columella, which is fissured or umbilicated; surface often smooth, occasionally ornamented with spiral striæ, or transverse tuberculations.

Gray places *Lacuna* in a separate family, but there does not seem to be sufficient reason for doing so. The only distinction from the animals of the other *Littorinæ* is the usual want of horny jaws and the presence of two small posterior appendages on the operculigerous lobe in *Lacuna*. Still these and the above-mentioned characters, that is, the ventricose or globular form of the shells, the existence of a fissured or hollow columella, the general smoothness of the surface and the flattened inner lip, would seem to make the distinction of a sub-family very desirable, without losing the idea of unity with other allied types of shells.

The principal genera included in this sub-family are the following:—

1. *Modulus*, Gray, 1840, including very characteristic globular or depressed forms, the columella terminating anteriorly with a strongly produced tooth and the margin of the aperture having anteriorly a shallow insinuation at the base.

2. *Lacuna*, Morton, 1827. A very large number of fossil species of this genus have been lately described by Deshayes from the Paris basin, and many of the forms show a very close relation to *Littorina*, differing, however, by their want of ornamentation. The classification of *Cythina* (? Conrad) is doubtful.

3. *Lithoglyphus*, Mühlfeld, 1821, (H. and A. Adams' Gen. I, p. 320). This genus is in some respects the fluviatile representative of *Lacuna* and *Littorina*. The form of the shell makes it very much allied to these two genera, and distinguishes it from similar forms of the *Rissoidæ*. Frauenfeld in his Monograph of *Lithoglyphus* (Verhandl. zool., bot. Gesellsch., Wien, 1863, Vol. XIII, p. 193, &c., and 1865, Vol. XV, p. 529, &c.), pronounces the expanded form of the inner lip, covering the hollow columella, as an important character of the genus, and it is principally on this account, that we would prefer to place *Lithoglyphus* rather in the *lacuninæ*, than in the *littorininæ*. Frauenfeld describes, in the above quoted papers, twenty recent species.

4. *Cremnobates*, Blanford, 1863, (Ann. Mag. Nat. Hist., Vol. XII, p. 184). The typical species of this genus described by Blanford is *Cr. Syhadrensis*. The shell very much resembles those species of *Littorina* which have a short spire and an inflated last volution. This species lives on the high cliffs near Bombay above the high water mark, and this may easily account for the very rudimentary state (or absence?) of the gills, which Mr. Blanford has not been able to detect. Troschel lately examined the teeth of this species, and found them identical with those of other *Littorinidæ*.* Mr. W. Blanford has since obtained several other species of this genus, found under similar circumstances. All the species are distinguished by a remarkably thin, horny looking shell, as compared with *Littorina*.

5. *Stenotis*, A. Adams, 1863, (Ann. Mag. Nat. Hist., XI, p. 351,) resembles *Lacuna*, but the inner margin of the aperture is detached from the shell.

6. *Lacunaria*, (Conrad; Smith. Misc. Coll., 1866, No. 200, Check list, eocene foss., p. 12). There are two species quoted, which were at first described under *Natica; L. alabamiensis and L. erecta*, Whitf. sp.

I do not know that any species, belonging to the sub-family *lacuninæ*, have up to the present time been noticed in cretaceous beds.

c. *Sub-family,—LITTORININÆ.*

Shell solid, conical or turbinate; last whorl usually enlarged in conformable proportion with the previous ones; spire pointed, generally moderately elevated; aperture roundish, entire in front; inner lip flattened, smooth, not grooved; centre of the basis occasionally impressed; surface of shell spirally grooved, often tuberculated or even spinose, rarely smooth.

There is only a small degree of difference between the characters of this and the previous sub-family, still it appears to be a convenient separation. The regularly spiral form of the shell, the ornamentation of the surface, and the smooth inner lip not being perceptibly enlarged, as well as the usual presence of a solid columella, are the most marked distinctions of the *littorininæ*, in which the following genera may be placed:—

1. *Amberleya*, Morris et Lycett, 1850. (Palæont. Society, London, Moll. Great Oolite, Univalves, p. 54;—*Eucyclus*, Eudes-Desl., 1860. Bull. Soc. Linn. Norm., Vol. V, p. 138). The authors of the 'Mollusca of the Great Oolite' proposed the name *Amberleya* (*Amberlya* seems to be a misprint) for certain fossil species, which resemble in form and ornamentation *Hamus* (=*Tectarius* or *Pagodus*), but have a remarkably thin shell. The best known species is the jurassic *Turbo capitaneus*, Münster; it is, however, readily distinguished from any of the *Trochidæ* by the want of any internal pearly layer of the shell. Mr. Eudes-Deslongchamps not being acquainted with the above name proposed, some time after the publication of the name *Amberleya*, that of *Eucyclus*. He described at the same time several

* The statement was communicated to me by the author himself. A notice of it is published, I think, in the "Archiv für Naturgeschichte" for 1867, but I have not yet received the paper in Calcutta.

characteristic species of the genus from the jurassic deposits of the Normandy. A large number of species described by D'Orbigny under the names of *Turbo* and *Trochus* belong to this genus.

2. *Hamus*, Klein, 1753 (*Tectarius*, Valenc.; *Pagodus*, Gray). This name of Klein has full authority; it is distinctly quoted in his list of genera and explanation of plates; the figure is a good one, (vide Tent. Meth. Ostr., p. 25, pl. 2, fig. 37).

3. *Echinella*, Swainson, 1840.

4. *Littorina*, Férussac, 1821. Probably the smooth species, with depressed spira, placed by Adams in the following sub-genus—

4 *a*. *Neritoides*, Brown, could be generically distinguished; they are nearly allied to *Lithoglyphus*.

4 *b*. *Spironema*, Meek, 1864 (Smith. Misc. Coll., No. 177, Check list cret. foss., pp. 19 and 35,) agrees in the thin structure of the shell with *Amberleya*, and gives the impression of being a not fully grown *Littorina*. Meek quotes two American cretaceous species, *Sp. tenuilineata*, Meek and Hayden, and *Sp. bella*, Conrad; the first has originally been described as a Turbo, and the second as a doubtful species of *Tuba;* Jour. Acad., Nat. Sc., IV, p. 289, pl. 46, fig. 38. Both species are spirally striated, like *Littorina*.

4 *c*. *Cyclonema* has been proposed by Hall (Palæon. of New York, 1852, Vol. II, p. 89,) for a number of palæozoic shells, which apparently do not differ in any essential characters from *Littorina*, excepting that the shell is stated to be somewhat thinner. A few species, which we had occasion to examine, have, however, hardly a thinner shell than many other species of *Littorina*. The surface is usually covered with fine spiral and transverse striæ.

5. A few large, and generally reversed species, like *Turbo Bertheloti*, d'Orb. (Pal. franc. jur. II, p. 337, pl. 328, figs. 7-8), or *Turbo Hörnesi*, Stol. (Sitz. Akad., Wien, 1861, XLIII, p. 176, pl. 2, fig. 14), from liassic deposits, have most probably to be separated into a distinct genus, belonging to this sub-family.

The same, or at least very similar forms, like *Echinella and Hamus*, have been referred by Sandberger and other palæontologists to *Littorina*. There is a large number of palæozoic, mostly smooth shells known under those names, exhibiting close relationship to the *Littorinidæ* in general, and most of them belong very probably to this family, though in some respects they resemble the *Chemnitziidæ* or *Naticidæ*. It will be sufficient here to refer to genera, like *Platyostoma*, Conrad, *Holopea*, Hall, *Macrocheilus*, Phillips, &c. Generally speaking, the *Littorinidæ* are represented among the oldest known Gastropoda, and they are found more or less in all sedimentary deposits.

It is difficult to understand for what reason D'Orbigny refused to acknowledge any cretaceous *Littorinæ*, and referred species, which were described under that name, to *Turbo*, *Trochus*, and other genera. This celebrated author's opinion, having been subsequently accepted by many palæontologists, has rather retarded the true knowledge of the fossil *Littorinidæ*. Even Pictet, in his last review of the cretaceous species of *Littorinidæ* (Mat. Pal. Suisse. 3me. Ser., Foss. Ste. Croix., p. 365), is not

certain of the determinations of any true cretaceous *Littorinæ*. He quotes with doubt *Litt. gracilis*, Sow., and *Litt. Roissyi*, D'Arch. The former is very probably a *Sandbergeria*, one of the sub-generic groups of *Cerithium*. Specimens from Blackdown, which I have examined in the London Geol. Soc'. Collection, are very similar to our *Cerith. antecedens*, (vide p. 202), which I found to be the same as Forbes' *C. Trichinopolitense*. The Blackdown specimens have the aperture anteriorly provided with a very short and shallow canal. *Litt. carinata*, Sow., sp. *(Turbo idem)* appears to be an *Amberleya*. There is, however, no reason why species like *Litt. elegans*, *L. decussata*, Desh., *L. extensa*, Sow., sp., *L. sculpta*, Reuss and several others, should not belong to this genus.

We have to notice from the South Indian cretaceous deposits the unusually large number of six new species, some of which are closely related to forms still existing in the neighbouring seas. The most peculiar is the *Litt. crassitesta*, belonging to a somewhat different type, having the outer lip posteriorly insinuated. It is, however, impossible in the present case to regard this character as of any important generic value, for the transitions to a broad and shallow insinuation, like that of *Litt. attenuata* and *L. inconstans*, are so gradual, that no possible limit can be fixed for it. In fact somewhat similar cases,—sometimes even developed nearly to the same extent,— can be observed in different varieties of the common *Litt. littorea*. Considering the small number of specimens, by which our Indian *Littorinæ* are as yet represented, we may expect large additions through farther examination of the respective grounds; for there are scarcely any other Gastropoda to be found in larger numbers, than the *Littorinæ* where they once have made their *habitat*.

LVII. LITTORINA, *Férussac*, 1821.

1. Littorina undata, *Stoliczka*, Pl. XX, Fig. 11.

Litt. testa elongata, apice acuminata; anfractibus planiusculis, suturis vix impressis junctis, levigatis, striis incrementi tenuissimis notatis; ultimo anfractu ad peripheriam convexo; basi producta; apertura ovato elongata, postice acuminata, antice sub-effusa; labio crassiuscula, levi.

Spiral angle 44°; sutural angle 9°.
Height of the aperture : total of shell ... (considered as 1·00) ... ... 0·45.
Width of penultimate whorl : its height ... („ „ „) ... ... 2·30.

Shell elongated, composed of flattened and smooth volutions with a narrowly ovate aperture, being slightly effuse in front. The striæ of growth are very fine, and a short distance below the suture slightly insinuated, corresponding with a shallow constriction of the whorls. The inner lip is thickened and smooth, as in other typical *Littorinæ*. The species belongs to the same group of smooth forms, as the recent *Litt. araucana*, D'Orb., *Litt. zebra*, Wood, and others, which are usually in a living state ornamented with different zigzag and variegated lines.

Locality.—Comarapolliam, in whitish sandstone; only a single specimen has as yet been found.

Formation.—Arrialoor group.

2. Littorina crassitesta, *Stoliczka*, Pl. XX, Figs. 16-17.

Litt. testa ovata, crassa, apice acuminata; anfractibus planiusculis, superioribus transversaliter oblique-costulatis, omninis postice ad marginem suturalem valde tumescentibus atque tuberculis rotundatis ornatis, duobus ultimis antice fere levigatis; striis incrementi infra marginem tumescentem valde insinuatis; ultimo anfractu subinflato, ad peripheriam convexo; basi producta, spiraliter obsolete late-sulcata; apertura ovali, postice acuminata, antice rotundata; labio crasso levigatoque; labro postice insinuato.

Spiral angle about 50°; sutural angle 6°- 8°.
Height of aperture : total of shell ... (considered as 1·00) ... ... 0·56.
Width of penultimate whorl : its height („ „ „) ... ... 2·00.

This is an ovate, strongly built shell with an acute apex, and the last volution somewhat inflated. The uppermost whorls are transversally ribbed, contracted posteriorly and angular near the middle. The succeeding whorls are flattened, smooth, posteriorly inflated along the suture, and provided with numerous rounded tubercles, which often become less marked, when they approach the aperture. The striæ of growth are strongly insinuated below the inflated posterior margin. The basis is produced and spirally sulcated, the sulci being, however, occasionally rather obsolete. The aperture is oval, posteriorly pointed and anteriorly rounded; the inner lip thickened and smooth; the outer attenuated and posteriorly more or less deeply insinuated. This strong insinuation of the outer lip is something unusual in *Littorina*, but, as I have already stated, there are such small differences in the degrees of this emargination, that it is impossible to use it as a generic distinction. With regard to the great thickness of the shell of *Litt. crassitesta*, I do not know any other species that could be better compared with it, than the *Tanalia acinosa*, Zek. sp. (olim *T. Pichleri*, Hörn., sp. Stoliczka, in Sitz. Akad., Wien, 1865, Vol. LII, Revision, etc., p. 56) from the Alpine-Gosau formation.

Locality.—Comarapolliam; not rare.

Formation.—Arrialoor group.

3. Littorina inconstans, *Stoliczka*, Pl. XX, Figs. 13-15.

Litt. testa ovata, apice acuminata; anfractibus convexis, postice valde contractis, sulcatis, in margine suturali tumescentibus, spiraliter multi-sulcatis, transversaliter striis incrementi minutissimis ornatis; basi convexa, similariter spiraliter sulcata; apertura ovata, postice acuta ac angustata; antice rotundata.

Spiral angle 57°; sutural angle 8°- 5°.
Height of the aperture : total of shell ... (considered as 1·00) ... 0·62.
Width of penultimate whorl : its height... („ „ „) ... 2·00.

This species very much resembles in form and ornamentation the recent *Litt. tessellata*, Phil. from the West Indies. It is ovate, with a short pointed apex, the whorls having the posterior margin thickened into a distinct keel, below which

they are constricted or grooved, and then uniformly enlarging till they again become slightly narrowed at the anterior suture. The entire surface is covered with numerous, close, spiral sulci, and the striæ of growth often produce a very fine crenulation on the ribbings which separate the furrows. The aperture is oval, anteriorly evenly rounded, posteriorly much narrower, and on the outer lip slightly insinuated. If we are correct in referring the specimen, represented in Figure 15 to this species, it would seem that on farther growth the sutural swelling becomes respectively stronger, but that the spiral sulcation nearly disappears. This large specimen, which does not otherwise exhibit any distinction in the form of the whorls, has been found in brownish sandstone near Olapaudy, the beds of which locality Mr. H. Blanford refers to the Arrialoor group.

Localities.—Kolakonuttom, N. of Alundanapooram, S-E. of Parchairy, in brownish or light coloured sandstone; only one specimen from each locality has been examined.

Formation.—Trichinopoly group.

4. Littorina acicularis, *Stoliczka*, Pl. XX, Figs. 9-10.

Litt. testa elongata, apice acuminata, ultimo anfractu sub-inflato, in junioribus speciminibus ad peripheriam subangulato; ceteris anfractibus planiusculis seu subconvexis, sutura impressa junctis, in superficie spiraliter multi-liratis: liris planis, sulcis angustioribus separatis, in medio anfractuum aliquanto subobsoletis; basi subplana, moderate producta; apertura late ovata, postice acuta, antice subrotundata; labio angulato.

Spiral angle 50°; sutural angle 15°.
Height of aperture : total of shell ... (considered as 1·00) ... ... 0·47.
Width of penultimate whorl : its height („ „ „) ... ... 2·10—2·36.

The spire in this species is considerably produced and pointed. The whorls are flattened or slightly convex, each of them provided with six or seven very narrow spiral sulci, which are separated by much broader, flat ridges. The last whorl is obtusely angulated at the periphery; the basis not much produced, and also spirally sulcated; the ridges being broadest at the periphery, and becoming gradually narrower towards the centre. The aperture is rather wide, posteriorly pointed, anteriorly broadly rounded; the inner lip angular; the outer lip arcuated, without any perceptible insinuation. There is in the young shell a slight fissure at the termination of the columella, but it disappears in advanced age.

Several recent species, like *Litt. Sieboldii*, Phil., *Litt. scabra*, Linn., and others from the eastern seas, are almost identical in form with our cretaceous shell. Young specimens, which have the whorls somewhat more convex, resemble the *Litt. Roissyi*, d'Arch. (Mem. Soc. Géol. France, 2me. Ser., Vol. II, p. 337, pl. 23, fig. 3) from the Tourtia beds.

Localities.—E. of Anapaudy, N. of Alundanapooram, and near Garudamungalum; only four specimens have as yet been procured.

Formation.—Trichinopoly group.

5. Littorina attenuata, *Stoliczka*, Pl. XX, Fig. 12.

Litt. testa elongata, acuminata; anfractibus postice prope marginem canaliculatis, in margine suturali paululum crassioribus, subconvexis atque levigatis; ultimo anfractu vix inflato, cylindraceo; striis incrementi postice paulo insinuatis; basi producta, spiraliter 6-7*—lirata; apertura ovate-elongata, antice sub-effusa; labio crassiusculo, levi; labro attenuato, postice late sed non profunde insinuato, antice intus obsolete-sulcato.*

Spiral angle 48°; sutural angle 9°.
Height of aperture : total of shell ... (considered as 1·00) ... ... 0·48.
Width of penultimate whorl : its height („ „ „) ... ... 1·70.

Shell elongated, of a rather cylindrical shape, the last whorl being very little more inflated than the previous ones, which are deeply canaliculated along the suture. The posterior margin itself is slightly thickened. The surface is smooth, except at the basis, which is provided with six or seven narrow, spiral grooves. The aperture is oval, much higher than broad, anteriorly somewhat effuse; the inner lip thickened, slightly arcuate, the outer one sharpened at the margin from within, anteriorly somewhat produced, with a few slight sulci internally, and posteriorly broadly but not deeply insinuated. Corresponding to this insinuation of the outer lip, all the striæ of growth are bent backward. The form of the shell is a little variable in its height, or rather in the width of the last whorl. For in the same proportion as this whorl becomes a little more inflated, the height of the shell is respectively somewhat reduced. The aperture is remarkably narrow in this species, and more resembles in this respect that of a *Melania*, than of a *Littorina*.

Locality.—W. of Parally (about five miles N. by E. of Moraviatoor), in a brown calcareous sandstone with some siliceous grains; rare.

Formation.—Ootatoor group.

6. Littorina strenua, *Stoliczka*, Pl. XX, Fig. 8.

Litt. testa turbinata, apice obtusiuscula; anfractibus convexis, postice ad suturam abrupte terminantibus, subcanaliculatis, spiraliter 5-6*—liratis, sulcis lirisque fere æqualibus; striis incrementi minutis, rectis; ultimo anfractu maximo, inflato, ad peripheriam rotundato; basi convexa, in medio paulo impressa, spiraliter sulcata; apertura subrotundata; labio tenui, ad medium angulato.*

Spiral angle 79°; sutural angle 9°.
Height of aperture : total of shell ... (considered as 1·00) ... ... 0·56.
Width of penultimate whorl : its height („ „ „) ... ... 2·80.

The strongly convex whorls and the depressed form of the shell place this species next to the recent *Litt. castanea*, Adams and Reeve, from our eastern seas, but its spiral sulci are more numerous and less distant from each other. The last whorl is much inflated, and on the periphery uniformly rounded. The basis is moderately produced; in the middle, somewhat impressed and spirally sulcated,

like the rest of the surface of the shell. The aperture is roundish, both the margins being rather thin, and the inner one angulated towards the termination of the columella.

The more elongated form and stronger spiral sulcation distinguish our Indian fossil from *Litt. decussata*, Desh. (Mem. Soc. Géol. France, 1er. Ser., Vol. V, pl. 17, fig. 6), which it otherwise greatly resembles. There is no other cretaceous species known, with which it can be compared. I must make an exception of those two species, for which Meek proposed the name *Spironema*, as I cannot make out the distinctive characters of that genus.

Locality.—N. of Odium, in a brown calcareous sandstone; only two specimens have as yet been found.

Formation.—Ootatoor group.

XXXI. *Family*.—*AMPHIBOLIDÆ*, vide H. and A. Adams' Gen. II, p. 268.

XXXII. „ —*VALVATIDÆ*, ibid., I, p. 343, (*Valvata* and *Lyogyrus*, Gill, Proc. Amer. Phil. Acad., 1863, p. 34).

XXXIII. „ —*AMPULLARIIDÆ*, ibid., I, p. 344.

XXXIV. „ —*VIVIPARIDÆ*,* ibid., p. 337.

XXXV. „ —*RISSOELLIDÆ*, ibid., p. 325.

Of these five families no representatives have as yet been found in our cretaceous rocks of South India. A few species of *Viviparus*, *Bythinia*, a. oth., have been described from the Wealden beds, but no such forms have as yet been reported from the cretaceous formations in general, though they most probably were not wanting in the fresh waters, which existed during that period.

With regard to the family *Rissoellidæ*, it is worthy of mentioning, that Deshayes lately established in his new edition of the Paris fossils (Vol. II, p. 383,) a new genus, *Lacunella*, for a species generally agreeing with *Lacuna*, the shell of which is, however, *thin* and *pellucid*. This structure of the shell combined with its form could scarcely be compared with any other recent species, than those of the family *Rissoellidæ*, to which it probably belongs. *Hyala*, placed by H. and A. Adams in this family, is stated to have more affinities with *Aclis*, and we shall mention the genus again, when speaking of the sub-family *chemnitziinæ* of the *Eulimidæ*.

* Gill (Arrangement etc., fam. *Viviparidæ* (Proc. Phil. Acad., 1863, p. 33, etc.) quotes four genera as constituting this family, *Tulotoma*, Haldeman, *Viviparus*, Lam., *Melantho*, Lea, and *Lioplax*, Troschel. Meek proposes for the jurassic species *Mel. (Potadoma) veterna*, Meek and Hayd., a new generic name, *Leioplacodes* (Smith. Misc. Coll. No. 177, 1864, p. 40); and Conrad has in the *Viviparidæ* a new genus *Campeloma* (Smith. Misc. Coll. No. 200, 1866, p. 12). *Paludomus* and *Tanalia* are referred to the *Melaniidæ*; and *Bithinia* and *Stenothyra (Nematura*, olim) to the *Rissoidæ*. The genera *Larina*, A. Adams, (a thin *Amphibola*—like shell,) and *Rivulina*, Lea, are added to the *Viviparidæ* in H. and A. Adams' Genera II, 624-625. See also *Larina Burmana*, Blanford, in Journ. As. Soc., Bengal, for 1867, p. 61, pl. 13, fig. 1.

XXXVI. *Family,—RISSOIDÆ.*

H. and A. Adams, Genera, I, p. 327; Gray, Guide, 1857, p. 96; Deshayes, Anim. s. vert. Foss. de Paris, etc., 2nd edit., Vol. II, p. 384; Schwartz von Mohrenstern, Monographie der Familie der *Rissoiden*, Denksch. Akad., Wien, 1861, Vol. XIX, pt. II, p. 71; and 1864, Vol. XXIII, pt. II, p. 1; Stimpson, Researches upon the *hydrobiinæ*, etc., Smith. Misc. Coll., 1865.

The *Rissoidæ* appear to be closely related to the *Cerithiidæ* (*Sandbergeria* a. oth.), as well as to the *Littorinidæ* and *Planaxidæ*, and pass on the other hand through the fresh-water species into the *Viviparidæ*, and through the amphibious forms to the operculated Pulmonata.

The animals have a produced, occasionally dilated rostrum, which is sometimes at its base more or less adnate to the forepart of the foot. In some the eyes are sessile at the upper base or near the outer margin of the subulate tentacles, in others they are placed on prolonged bulgings, which are for a short or the total distance united with the tentacles. The teeth are in seven series, all of them with incurved tips; the central being subconic and denticulated like the internal lateral ones; the two outer lateral pair are dissimilar, elongated, with converging tips, and also finely denticulated. No necklobes are known to occur in any of the species. Foot small, roundish, or with a more prolonged basis, at its posterior end sometimes terminating with short appendices. If the disc of the foot is small, the anterior part of the head or rostrum assists them in walking, or rather looping, as is the case with many of the litoral or amphibious species; those species, however, which do not live above the low tide mark, and are therefore permanent inhabitants of the water, have the foot longer and adapted for sliding.

Operculum horny, subspiral, with lateral or central nucleus; occasionally testaceous with subannular nucleus.

Shell more or less turreted, small, ovately elongated, rarely depressed; aperture ovate, anteriorly rounded or effuse, with entire margins.

The *Rissoidæ* are mostly small shells, which seldom live in deep water, but usually on different sea-weeds in the litoral zone. Many of them are also inhabitants of brackish and fresh waters, and a small number are only found on moist places along the sea-shore, or on banks of rivers, estuaries, &c. Corresponding to their mode of life seems to be the development of the gills, which undergo variations, similar to those noticed in the *Littorinidæ*.

With respect to the definition of the family itself, as well as to the number and value of the generic denominations, conchologists are by no means agreed; and this in spite of the great attention, which these little shells have received within the last few years. Species, which are evidently of very similar habits and have shells of similar form and structure, are either found distributed in different families, or they are by others not acknowledged to be even entitled to generic distinction. Such contradictory opinions are daily pronounced in conchological publications.

Schwartz von Mohrenstern (loc. cit.) has made the family a subject of monographic research, and we already owe to his labors monographs on the genera

Rissoina and *Rissoa*. Deshayes, in his last edition of the Paris fossils, made several additions to the number of the genera in this family, and gives a general review of the same. He much regrets the want of criticism in Schwartz' paper, in which the genera are provisionally adopted according to H. and A. Adams' determinations in their work on the 'Genera of recent shells.'

The latest attempt at a classification of the *Rissoidæ* was made by W. Stimpson, (loc. cit.), who views the family in a somewhat broader sense, than has been done by previous writers. He proposes to distinguish six sub-families, each with a certain number of genera. Already before the receipt of Stimpson's paper I intended to group the whole family into at least two divisions. The one was to have principally included the brackish, freshwater or amphibious genera, the shells of which are usually thin and smooth, and the labrum not thickened externally; the other the marine genera with thick, solid shells and, as a rule, with the labrum externally thickened. The animals of all the *Rissoidæ* are very similarly formed, but those living in fresh or brackish waters have generally no appendages on the posterior portion of the foot, and the operculigerous lobes are less developed, than in the marine forms. The eye-peduncles are generally united with the tentacles, but it seems that their length increases, the more the animal is accustomed to an amphibious life. Thus some of the species have the eyes placed near the basis of the tentacles, others in the middle, and still others at the tips of the same. The differences are very gradual, which makes it impossible to regard them as of any important generic value. The length of the rostrum also appears to increase in some forms, corresponding with their more amphibious habits; and also, while the foot itself often lengthens, its disc at the same time becomes smaller.

Mr. Stimpson's researches enter into great details relating to the family, and we fully agree with most of his propositions. We would only wish to make one or two additions and alterations in the genera, as well as in the sub-families, and give therefore a very cursory review of the same, referring for more details to the paper quoted above.

a. *Sub-family,—BITHINIINÆ,* including—

1. *Bithinia,* Gray 1821, (Genera I, p. 341). The first known fossil species of this genus are from the Wealden and a large number from the tertiary deposits. None have as yet been reported from the cretaceous period.

b. *Sub-family,—HYDROBIINÆ,* with the following genera—

1. *Bithinella,* Moqu. Tand.
2. *Stenothyra,* Bens.; Deshayes in his new edition of the Paris fossils, describes a few eocene species of *Stenothyra* under the name of *Bithinia.*
3. *Hydrobia,* Hart. Most of the known species have been lately catalogued by G. von Frauenfeld (Verh. Zool. bot. Gesellsch., Wien, 1864, Vol. XIV, p. 561, etc.; and 1865, Vol. XV, p. 525).

4. *Littorinella*,* Braun, is considered by H. and A. Adams as identical with the last, but not so by Stimpson.

5. *Amnicola*, Gould and Hald., 1839; Genera I, p. 336. See also Frauenfeld's list of *Paludina*, Verh. Zool. bot. Gesells., Wien, 1864, Vol. XIV, p. 561, etc.

6. *Gabbia*, Tryon (Am. Journ. Conch. I, p. 220,) is like *Amnicola*, but has a calcareous, paucispiral operculum.

7. *Tricula*, Bens., based upon a fresh-water species, *T. montana*, from the Hymalayas. The shell is thin as in *Lymnea*, but the aperture exactly similar to *Hydrobia*.

8. *Pyrgula*, Christ and Jan., with the whorls strongly carinated.

9. *Paludestrina*, D'Orb., has been usually regarded as identical with *Lithoglyphus*, Mühlf., but Stimpson considers them as distinct.

10. *Tryonia*, Stimpson, with transversally ribbed whorls.

11. *Pomatopyrgus*, Stimps., with a conical shell and the whorls ornamented with spinous tuberculations.

Stimpson further quotes in this sub-family *Cochliopa*, Stimps.; *Gillia*, Stimps.; *Somatogyrus*, Gill; *Lithoglyphus*, Mühlf.; *Fluminicola*, Stimps. With the exception of *Lithoglyphus*, which we have for some obvious reasons placed in the family *Littorinidæ*, we are personally not acquainted with any species of these last named genera. From the general accounts given, we would prefer to classify them in the *Littorinidæ*, with which both the form and structure of the shells, and also the dentition, so far as it has been made known, seem better to agree.

We are equally uncertain how far we could be justified in placing in this sub-family the genus *Moitesseria*, Bourguignat, the shell of which resembles *Hydrobia*, but has the outer lip provided with a notch, resembling that of *Chittia*. It is therefore possible, that the genus belongs to the *truncatellinæ*. Likewise uncertain is the position of *Poladilhia*, Bourguignat, which has a similar shell.

More correct appears to us the classification of the following genus which ought not to be excluded from the *Rissoidæ*, though it may also be advantageously placed in the next sub-family.

12. *Paludinella*, Pfeiffer, 1841, (Genera, II, p. 315). Frauenfeld (Verh. Zool. bot. Ges. Wien, 1863, XIII, p. 199), opposes H. and A. Adams' classification of this genus at the end of all the Neurobranchia. He says that, so far at least as the fresh-water species are concerned, they are by no means amphibious in their habits, for he observed a large number of species which never left the water. There are, however, several species known,—apparently not generically different from other *Paludinellæ*,—which are generally only found in moist places, though always near the water. Frauenfeld enumerates 28 species of *Paludinella*, the greater number of which are found in Southern Europe.

* *Diala* has been applied by A. Adams (Ann. Mag. 1861, VIII, p. 242,) to a small marine shell, resembling in form a *Hydrobia*, but with a slight insinuation in front of the aperture. It may probably be better classed next to *Alaba* in the sub-family *litiopinæ*, (fam. *Planaxidæ*).

c. *Sub-family,—POMATIOPSINÆ.*

According to the accounts given by Stimpson of the animal of *Pomatiopsis* we have no hesitation in including in this sub-family the following genera:—

1. *Assiminea*, Leach., 1819, (Syn. *Optediceros*, Leith), (H. and A. Adams, Gen., II, p. 314). The shells of the *Assimineæ* are much thinner than those of the *Littorinidæ*, the teeth of the radula are similar to other *Rissoidæ*, but very different from those of the former family, and also from those of the *Viviparidæ*. Gray's statement (Guide, 1857, p. 87,) with reference to the eye-pedicles being united with the tentacles in their entire length, is perfectly correct. Our common *Ass. Francesiæ* can be often seen for days together on dry land, walking or rather leaping with great rapidity like a caterpillar of the *Geometridæ*. As the animal proceeds, the rostrum and the small foot are moved alternately. There are still many doubtful points in the anatomy of *Assiminea*. Jeffreys at first says (An. Mag., 1859, III, p. 108), that *Ass. Grayana* and *littorea* are 'decidedly *Pectinibranch*', and in a more recent communication *(ibid.*, 1866, XVIII, p. 309), he states, that *Assiminea* is undoubtedly marine and 'pulmonobranch.'

Frauenfeld enumerates in his monograph of the genus only five species (Verh. Zool. bot. Gesells. Wien, 1863, XIII, p. 210) namely, *A. Francesiæ*, Gray; *A. atomaria*, Mühlf.; *A. ovata*, Krss.; *A. fragilis*, Quoy; *A. sordida*, Behm. To these have to be added *A. latericea*, H. and A. Adams' (Proc. Zool. Soc., Lond., 1863, p. 434); *? A. subrotundata* and probably *? Paludinella castanea*, Carpenter, (Ann. Mag. N. Hist., 1865, XV, p. 28); *A. lutea* and *cincta*, A. Adams, 1868, (An. Mag. VIII, p. 307) from Japan; *A. carinata*, Lea; *A. pinquis*, Mart.; *A. miniata*, Mart.; *A. Grayana*, Leach; *A. Charreyi*, Morel.; *A. helicoides*, Gundlach; *A. radiata*, Pfr.; *A glabrata*, Pfr.; *A. lirata*, Morel.; *A. albescens*, Pfr.; *A. solidula*, Pfr.; *A. ventricosa*, Homb. and Jacq.; *A. rosea*, Gould; *A. bulimoides*, Homb. and Jacq.; *A. dubia* and *Huaheinensis*, Pfr.; *A. maritima*, Montrouzier; and probably also *Realia producta, abbreviata* and *fragilis*, of Pease; *Laguncula pulchella*, Benson, and *Paludina pulchella*, Hutton. (Vide Martens in Ann. Mag. Nat. Hist., 1866, XVII, p. 202, etc.); farther *Ass. rubida* and *debilis*, Gould, Proc. Boston Society, VII, p. 41; *As. (Optediceros) cornea*, (not *idem* Pfr.), *subconica* and *marginata*, Leith, Bombay Roy. As. Soc., V, p. 145); *A. rubella*, Blf. (Journ. As. Soc., Bengal, 1867, pt. I, p. 55, pl. 13, figs. 11-12) from the Irawadi Delta, and *A. rotundata*, Fairbank, (apud Blanford in Ann. Mag. Nat. Hist. for 1868) from the neighbourhood of Bombay.

2. *Pomatiopsis*, Tryon, the animals of which mostly live out of water and are truly amphibious. The foot is similarly constructed to that of *Assiminea*, and the mode of progression is also similar.

d. *Sub-family,—TRUNCATELLINÆ.*

Though Stimpson excludes this group of shells from the *Rissoidæ*, we hardly believe that there is sufficient reason for doing so. The animals do not differ essentially, and in many respects they very closely resemble those of the previous sub-family.

1. *Truncatella*, Risso, 1826, (Adams' Gen., II, p. 310). The species live usually under wet grass on the sea coast. Deshayes, who describes several eocene species in his new edition of the Paris fossils, also places this genus in the *Rissoidæ*.

2. *Taheitia*, H. and A. Adams, 1863, (Ann. Mag. Nat. Hist., XI, p. 19,) is a *Truncatella* with a shelly operculum.

3. *Cecina*, A. Adams, 1861, (Ann. Mag. Nat. Hist., VIII, p. 308,) only differs from *Truncatella* in having the surface of the shell smooth, and the outer lip somewhat produced near the middle.

4. *Tomichia*, Benson, 1851, (Adams' Gen., II, p. 313,) is founded upon a shell resembling the last; the animals are also alike, except that the bulgings of the eyes are somewhat more distinct. Species of *Tomichia* have been found in South Africa, India and Japan, (vide A. Adams in Ann. Mag. Nat. Hist., 1861, VIII, p. 308).

5. *Blanfordia*, A. Adams, has been separated for species like *Tomichia Bensoni* and *Japonica*. The shells are chiefly distinguished from those of true *Tomichiæ* by the thickened margins of the aperture and by the outer lip, which is externally sub-varicose.

6. *Geomelania*, Pfeiffer, 1845, (Gen. II, p. 311,) are said to be more terrestrial than *Truncatella*, which they otherwise very much resemble. The species are principally inhabitants of the island of Jamaica.

7. *Chittia*, Livesay, 1858, (Adams' Gen., II, p. 647,) differs from *Truncatella* by a posterior insinuation of the outer lip. Deshayes describes an eocene species under the name of *Aciculina emarginata*, (Paris foss., 2nd. ed., II, p. 533, pl. 25, figs. 25-27).

8. *Micropyrgus*, Meek, 1866, (Conrad in Smithsonian Misc. Coll., n. 200, Check list of eocene fossils, p. 12). Shell minute, smooth, sub-cylindrical, with obtuse apex and rhombic aperture; the type is *Mel. minutula*, Meek and Hayd. (Proc. Acad. Nat. Sc., 1856), which was found fossil in association with fresh-water shells. It is probable that the genus belongs to this sub-family.

e. *Sub-family,—SKENEINÆ.*

Stimpson only places in this sub-family *Skenea*, Fleming, (H. and A. Adams' Gen. I, p. 335,) but it is very probable that *Adeorbis*, Wood, 1842, (*ibid.* p. 407) has to be classed in the same. Deshayes says in his last edition of the Paris fossils, that the animal of *Adeorbis* is not essentially different from that of *Rissoa*. Some other species referred to *Liotiidæ* also show great similarity, in the structure of their shells, to those of this sub-family.

f. *Sub-family,—RISSOINÆ.*

The following genera, which are mostly marine and largely represented in a fossil state, belong to this division:—

1. *Setia*, H. and A. Adams, 1854, (Gen. I, p. 333).

2. *Cingula*, Fleming, 1828, (*ibid.* p. 334).

3. *Ceratia*, H. and A. Adams, 1854, (*ibid.* p. 333,) has the tentacles flat and short, like most of the *hydrobiinæ*, but the foot has appendices like other *rissoinæ*. The shell is thin, but distinctly spirally striated.

4. *Barleeia*, Clark, (Gen. I, p. 322).

5. *Fairbankia*, Blanford, (Ann. Mag. Nat. Hist. for 1868.) This genus has been lately proposed for a species from the Bombay Coast, *F. Bombayana*, Blf.

The shell is conically elongated like a Rissoina, of moderate thickness, covered with a brown epidermis and with numerous spiral striæ; aperture ovate, internally smooth, anteriorly roundish, edge of the outer margin sharp, but externally thickened into a distinct varix. Operculum thin, horny, sub-annular, with a lateral nucleus near the middle of the internal edge, and provided on the interior side with a raised rib. The form of the animal agrees with that of true Rissoæ.

The greater thickness of the shell and *the external varix of the labrum in Fairbankia* principally distinguish it from *Barleeia*. Forbes and Hanley (Moll. III, p. 120,) say that the shell of *Rissoa (Barleeia) rubra* is quite smooth, while H. and A. Adams, (Gen. I, p. 332,) record a spiral striation. The operculum of *Barleeia* is stated *to be interiorly testaceous, with a raised rib and an apophysis which projects from the nucleus*, while in *Fairbankia* the operculum is *thin, horny, internally with a raised rib, but without an apophysis*. It is evident from this, that both the last named genera are closely allied, but still in some respects so characteristically different, as to be able to be generically distinguished. Gray (Guide, 1857, p. 111) proposes for *Barleeia* a distinct family, apparently chiefly on account of the existence of a testaceous operculum. This separation is, however, hardly necessary, for we have a number of other similar instances of difference in the opercula, as in the BITHINIINÆ, HYDROBIINÆ, and others.

6. *Fenella*, A. Adams, 1860, (Ann. Mag. VI, p. 336,) is a pupoid form of *Rissoa* with spiral and transverse ribbings, but the outer lip without a varix.

7. *Mohrensternia*, Stoliczka, 1868.—Next in the series, with respect to the structure of the shell, appear to follow those fossil species of the RISSOINÆ, which Schwartz von Mohrenstern pointed out in his Monograph of *Rissoa*, p. 12 (Denksch. Akad., Wien, 1864, Vol. XXIII, pt. II,) as forming a separate section of that genus, like *R. angulata*, Eich., *R. inflata*, Andrz. and others; they occur in the brackish or fresh-water deposits of central and eastern Europe. The characters of the genus may be described as follows—

Mohr. testa turriculata, tenui, semipellucida; anfractibus sæpissime transversaliter costulatis; columella ad basin aliquantisper fissurata; apertura subovata, postice angulata, antice rotundata; marginibus interdum, (præcipue antice) paulo dilatatis; labio intus levi, labro extus haud varicoso, simplici.

Operculum atque animal incognitum.

In a quantity of sand, which I received from the Arakan Coast, were a number of shells, which extremely resemble the fossil species of *Mohrensternia*, but they were all dead specimens without opercula and with the surface partially worn off, which makes it somewhat doubtful whether they belong to this genus, for such forms could possibly be imperfect specimens of *Alaba*.

8. *Onoba*, H. and A. Adams, 1854, (Gen. I, p. 331). Shell of moderate thickness, partially covered with transverse ribbings; margins of the aperture

thickened. (List of species of *Onoba vide* Ann. Mag. Nat. Hist., 1861, VIII, p. 299, and 1863, XI, p. 348).

9. *Diastoma*, Deshayes, 1848, (Traité de Conch., p. 46, pl. 74, figs. 8-9, Paris foss., 2nd edit., II, p. 411). Shell turreted, whorls with numerous transverse ribs, and with a few intermediate varices. Inner margin of the aperture partially detached from the previous whorl; the aperture itself is strongly contracted posteriorly. As yet only known fossil in tertiary deposits.

10. *Ampithalmus*, Carpenter, 1865, (Ann. Mag. Nat. Hist., XV, p. 181), appears to be a somewhat similar form, but with a shorter spire. The species are recent, (*vide* also H. Adams in Proc. Zool. Soc., Lond., 1865, p. 754).

11. *Iravadia*, Blanford, 1867 (Journ. As. Soc., Bengal, pt. I, p. 56, pl. 13, figs. 13-14) is founded upon a species, *I. ornata*, which was found under stones in one of the creeks of the Irawadi-delta. The shell has the general form of a *Rissoa, but the apex is often obtuse, the whorls are spirally ribbed, covered with an epidermis; aperture ovate with continuous margins, anteriorly slightly effuse; the outer lip with an external varix. Operculum and animal are unknown.*

Schwartz von Mohrenstern in his Monograph of *Rissoa* does not mention a single species with spiral ribbings, and under *Rissoina* only one species, the *R. sulcifera*, Troschel (Denksch. Akad., Wien, 1861, XIX, pt. II, p. 182, pl. 10, fig. 83). A similar species has been found in loose sand brought from the Arakan Coast, though unfortunately the unique specimen is not better preserved, than the one described by Troschel. From a quantity of sand, picked up by Mr. S. Kurz on the shore of Termoclee (one of the Andaman Islands), I obtained another species which is very like the *Iravadia ornata* of Blanford, but the spiral ribbings are three on each whorl and somewhat thinner than in that species, the apex is not decollated, and the surface apparently without epidermis and of a pure white, like *Rissoæ* generally are. I am, however, informed by Mr. G. Nevill that the same, or a very similar species, is found in brackish water on the southern coast of Ceylon, and has when alive a brown epidermis. It is therefore a true *Iravadia*.

12. *Alvania*, Risso, 1826, (H. and A. Adams' Gen., I, p. 330).

13. *Rissoa*, Frémenville, 1814, (*ibid.* p. 329, *vide* postea p. 277).

14. *Scaliola*, Adams, 1860, (Ann. Mag. Nat. Hist., VI, p. 120), an elongated, smooth, *Turbonilla*—like shell; the animal is, however, stated to possess a rostrum, like the *Rissoidæ*. A fossil species was described by Semper, *Sc. Mohrensterni*, from the oligocene beds near Latdorf, (*vide* Journ. Conch., 1865, V, p. 432).

15. *Microstelma*, Adams, 1863, (Ann. Mag. Nat. Hist., XI, p. 347), has been proposed for another shell like a *Rissoina*, or rather *Turbonilla*, with the aperture somewhat produced in front; the outer lip is simple, and the whorls transversally ribbed. A. Adams describes a recent species from Japan, *M. dædala*, and Semper refers a tertiary fossil species to this genus, *R. Bellardii* (Journ. Conch., 1865, V, p. 434).

16. *Pterostoma*, Deshayes, 1864, (Paris foss., 2d. edit., II, p. 428,) has been proposed for *turreted Rissoina—like shells with the margins of the aperture much expanded.* There is only one species known from the Paris basin, and described

by Deshayes as *Pt. tuba*. The inner space of the aperture is not circular, and therefore very different from that of *Chilocyclus* (*Cochlearia*, olim); it is moreover oval, as in the sub-generic type *Zippora*, Leach, (*Rissoa auriscalpium*, Linn.,) from which the generic differences are not very great. The recent *Scalaria bicarinata* of Sowerby from one of the Philippine Islands* probably belongs to this genus.

g. Sub-family,—RISSOININÆ.

The genera are well characterized not only by the form of the operculum, but especially by the form of their aperture, which is *anteriorly effuse or truncate; the outer lip being peculiarly produced either anteriorly or near the middle.*

1. *Rissoina*, d'Orbigny, 1840, (H. and A. Adams' Gen. I, p. 327); *vide* postea p. 279.

2. *Bacula*, H. and A. Adams, 1863, (Ann. Mag. Nat. Hist., XI, p. 18); a shell resembling a *Eulima*, but without enamel covering; the whorls are spirally striated, inner lip thickened, as in the next genus, but the outer lip is without a varix and produced either in the middle or somewhat anteriorly. The classification of *Bacula* in this place is only provisional.

3. *Keilostoma*, Deshayes, 1848, *vide* postea p. 280.

Thus viewing the large number of generic forms,† which have been quoted as constituting the family *Rissoidæ*, we have before us a large series of apparently different shells. Those inhabiting the sea have usually a strong, solid shell, and are richly ornamented with striæ or ribs; the brackish water forms have a thinner shell, though often ornamented in a similar manner, while the shell of the fresh-water and the amphibious species is generally thin and smooth. All of them are so closely connected by gradual transitions, that there can be little doubt as to their forming one natural family, and one to which there is hardly any other equal in importance and general interest. It is true that subsequent researches,—especially in fossil Conchology,—will undoubtedly bring us numerous additions, but even with our present knowledge of the family, we can be certain that there scarcely appear, in any other known group of shells, such gradual transitions from the aquatic to the terrestrial forms, comparatively so easily traceable as in this one. The long disputed point as to the relations of the Prosobranchia and Neurobranchia (or operculated Pulmonata,) promises to obtain very valuable explanations through the study of the *Rissoidæ*. For the species of *Truncatella*, *Tomichia*, *Geomelania*, *Hydrocœna*, and others, are exactly those which lead us to *Pomatias*, *Helicina*, and others, the larger number of which are still found in damp places along the sea-coast. Within the family *Rissoidæ*, the natural succession of the sub-families would be about as follows : *RISSOININÆ*, *RISSOINÆ*, *SKENEINÆ*, *HYDROBIINÆ*, *BITHINIINÆ*, *POMATIOPSINÆ*, *TRUNCATELLINÆ*.

* Lately collected by G. Nevill on the south-coast of Ceylon.

† We have excluded from this family the genera *Mesostoma* (vide p. 189) and *Litiopa*, both of which are classed in it by Deshayes. Some of the species of the genus *Bugesia*, Bourg., probably belong to the *Viviparidæ*, and *Bugesia Bourguignati*, Poladilhe, (Nouv. Miscel., Malacoz. I, fasc. Paris, 1866,) is likely to be a form of the *Melanidæ*.

These studies on the changes of organisation, as produced by different modes of life, characterize our progress in natural science of later years, a step in progress towards the solution of that still mysterious question, *the development of organic life;* they are, however, the only means through which we can ever hope to arrive at a system deserving the name *natural.* From the instructive tablets, referring to the development of specific distinction in the genera *Rissoina* and *Rissoa,* as given in the Monographs of Schwartz von Mohrenstern, it is clearly visible how much that author appreciates the importance of this course of study, and it is only to be hoped, that he will extend his already successful investigations to all the forms, which appear to constitute this natural family.

In our cretaceous deposits of Sth. India only three genera have been found represented, and they are at the same time those, to which,—speaking generally,—every cretaceous species of *Rissoidæ,* hitherto discovered, belong.

LVIII. RISSOA, *Fréminville,* 1814.

Char. *Riss. testa oblonga, turrita, crassa; anfractibus sæpissime transversaliter costulatis; apertura ovata, integra, marginibus junctis; labro paululum expanso, extus varice incrassato, intus levi; columella solida, in medio labii truncate terminanti seu torta.* (Vide Denksch. Akad., Wien, 1864, Vol. XXIII, pt. II, p. 4,—with slight alterations).

Schwartz von Mohrenstern is of opinion, that the genus *Rissoa,* as restricted within the above characters, has no representatives below the tertiary epoch, but I cannot help thinking that he is misled in this statement, unless we can admit that different genera ought to be framed for different formations. When we base a generic distinction upon great differences existing between the animals of two very similarly formed shells, we are entitled to do so, because some distinctions will also generally be afterwards traced in the shells. Where, however, these latter are the only materials accessible to our examination, we cannot go beyond the characteristics, which we regard as generically common to a certain number of shells. I do not say anything about the jurassic species, although I am convinced that several of them are true *Rissoæ.* As to the existence of several cretaceous species of *Rissoa,* there cannot be, however, any serious objections made. I will mention, for instance, the species known as *Rissoa Dupiniana,* D'Orb. (Pal. franç. crét. II, pl. 155, figs. 8-10,) from the Gault of France, and another as *Rissoa affinis,* Sow. sp., from the Gosau-deposits (Sitzb. Akad., Wien, 1865, Vol. LII, Stoliczka's Revision, etc., p. 19). I add to these, two new species from South India *R. Oldhamiana* and *R. tropica.*

As very doubtful species, which most probably have to be excluded from this family, may be mentioned *R. incrassata* and *R. Sandbergeri,* Müller (Petræf. Aachner Kreidef., 1851, pt. II, pp. 76 and 77), both of which would rather belong to the *Nassinæ* of the *Buccinidæ,* although this could only be proved by the

discovery of specimens with perfect apertures. The *Rissoa Winkleri* of the same author is a *Keilostoma*.

1. Rissoa Oldhamiana, *Stoliczka*, Pl. XVI, Fig. 9; Pl. XX, Fig. 18.

Riss. testa turrito-elongata, apice acuminata; anfractibus convexis, spiraliter numerose striatis, transversaliter costulatis; costulis fere rectis, ad marginem anteriorem atque prope medium evanescentibus; columella solida, ad terminationem conspicue torta; apertura ovata, parum obliqua, antice sub-effusa, postice rotundate angulata; labro extus varicoso, in margine acuto.

Spiral angle 35°; sutural angle 15·5°.
Height of aperture : total of shell ... (considered as 1·00) ... 0·36.
Height of penultimate whorl : its width („ „ „) ... 0·57.

Shell rather elongated and turreted, composed of numerous, strongly convex volutions, the last of which is shorter than the spire. Each whorl is ornamented with many spiral striæ and with transverse ribs, which are almost straight and become obsolete towards the anterior margins, as well as on the middle portion of the last volution. The basis is considerably produced and also spirally striated. The aperture is oval, somewhat oblique and anteriorly obsoletely effuse; the outer lip with a strong, external varix, but sharp on the peristome itself; the columella distinctly twisted at its termination.

Locality.—Garudamungalum; only two specimens have been found in bluish, calcareous sandstone.

Formation.—Trichinopoly group;—principal beds of *Ammonites peramplus*, Mant.

2. Rissoa tropica, *Stoliczka*, Pl. XX, Fig. 19.

Riss. testa ovate elongata, spira conica, acuminata; anfractibus paulo convexis, spiraliter striatis, transversaliter costulatis; una vel duabus striis anticis ceteris fortioribus, costulis arcuatis decussantibus minute-granulosis; ultimo anfractu subinflato; basi producta, spiraliter striata, striis anticis fortioribus; apertura ovate obliqua, antice sub-effusa; labio incrassato; columella ad terminationem torta; labro extus varicoso.

Spiral angle 50°; sutural angle 7°.
Height of aperture : total of shell ... (considered as 1·00) ... ... 0·45.
Height of penultimate whorl : its width („ „ „) ... ... 0·37.

An elongated, ovate and somewhat tumid shell, the whorls being slightly convex, the last a little ventricose. Each of the whorls is ornamented with spiral striæ, which are crossed by very numerous, but thin and curved, transverse ribbings, so as to produce a fine granulation. One or two of the spiral striæ near the anterior margin are usually somewhat thicker than the rest. The basis of the last

volution, on which the transverse ribs become obsolete, is considerably produced and spirally striated, the more central striæ being the strongest. The aperture is ovate, oblique, anteriorly somewhat produced, and obsoletely effuse; the inner lip thick, especially posteriorly; the columella distinctly twisted; the outer lip with a strong external varix.

Locality.—N. E. of Odium, in brown calcareous sandstone; only one, but almost perfect specimen has been found.

Formation.—Ootatoor group;—principal beds of *Ammonites rostratus, (inflatus)* Sow.

LIX. RISSOINA, *d'Orbigny*, 1840.

Char. *Riss. testa elongate turrita, acuminata, sæpe striis spiralibus atque costulis transversalibus ornata, rare levigata; apertura obliqua, integra, postice acute-angulata et angustata, antice effusa; labro sinuato, versus basim producto, extus incrassato; columella solida, antice truncata seu plus minusve abbreviata. Operculum corneum, sub-spiratum, intus cornutum. (Vide* Denksch. Akad., Wien, 1861, XIX, pt. II, p. 102).

The distinctions between most of the recent species of *Rissoa* and *Rissoina* are very distinctly traceable through the characteristic form of the aperture, and the same distinctions also apply to the fossil ones. Deshayes, in his last edition of the Paris fossils, only accepts the genus *Rissoina* with great hesitation, stating that it is very difficult to distinguish in fossil species, whether they belong to *Rissoa* or to *Rissoina.* He justly points to the few instances, in which the operculum of a *Rissoina* has been made known, but I rather think that all these difficulties of generic determinations in fossil Conchology chiefly arise from the insufficient preservation of the specimens.

Schwartz von Mohrenstern considers all the species older than tertiary, as being rather doubtful. There may be some good reason for this, but I do not see the impossibility that *Rissoinæ* may not have existed even long prior to the cretaceous period, though from this formation only two species have as yet been reported; *R. incerta*, d'Orb. (Pal. franç. crét., II, pl. 155, figs. 11-13), and *R. Jaccardi*, Pict. et Camp. (Mat. Pal. Suisse, 3me. Ser. Foss., Ste. Croix., p. 348, pl. 74, fig. 1). Guéranger (Essai d'un rept. paléont. du dept. Sarthe, etc., Mans., 1853, p. 29,) names a species, *R. Cenomanensis*, but I suspect it is the same which he afterwards figures as *Eulima Cenomanensis*, though he does not say so, (see Album pal. dept. Sarthe, etc., le Mans., 1867, pl. 9, fig. 13). The species is evidently, however, neither a *Rissoina* nor a *Eulima*, but a true *Keilostoma.*

We have to report from South India one species, which is identical with a shell described by Prof. Müller from the upper cretaceous beds near Aachen.

1. Rissoina acuminata, *Müller, sp.*, Pl. XXV, Fig. 1.

1851. *Eulima acuminata*, Müller, Petræf. der Aach. Kreidef., pt. II, p. 9, Pl. III, Fig. 8.

Riss. testa elongata, aciculata, tenui, levi atque polita; anfractibus 9-10, *subconvexiusculis, ad suturam posteriorem paulo angustioribus, adpressis; apertura ovata, postice acute angulata, antice dilata; labro extus paulo incrassato, antice sinuose producto.*

Spiral angle 24°; sutural angle 12°.
Height of aperture : total of shell ... (considered as 1·00) ... 0·30.
Height of penultimate whorl : its width („ „ „) ... 0·67.

This interesting little shell is rather elongated, with a pointed apex, thin and perfectly smooth like a *Eulima*. The whorls are numerous, slightly convex, and along the posterior suture somewhat constricted. The basis of the shell is produced; the aperture oval, pointed posteriorly, anteriorly broadly rounded and subeffuse; the inner lip is thin and evenly curved; the outer lip externally, near the margin, slightly thickened, and anteriorly distinctly produced and somewhat enlarged.

These last characters clearly mark the species as a *Rissoina;* it is closely allied to D'Orbigny's *R. incerta*, though readily distinguished from it by its smaller height and the posterior constriction of the whorls.

Prof. Müller's figure is very deficient, but I lately had an opportunity of examining the original specimen of this supposed *Eulima*, and was astonished to see it perfectly well preserved. This is partially evident from Dr. Müller's description, in which he draws special attention to the thin and translucent structure of the shell. In this respect the species can only be compared with the recent *Riss. vitrea*, Adams (Schwartz v. Mohr. loc. cit., p. 181, pl. 10, fig. 82), the shell of which is also quite smooth and transparent; it has, however, a larger spiral angle than ours. The recent species is from Jamaica.

Locality.—In whitish sandstone near Comarapolliam; only the specimen figured has as yet been found.

Formation.—Arrialoor group.

LX. KEILOSTOMA, *Deshayes*, 1848.

Anm. s. vert. foss. de. Paris, 2me. edit. 1864, Vol. II, p. 422.—Stoliczka, Sitzungsb. Akad., Wien, 1865, Vol. LII, Revis. etc., p. 20.

Char. *Keil. testa elongata, turriculata, superficie sæpissime sublevigata; apertura ovata, obliqua, integra, postice angustata atque subcanaliculata, antice truncata atque sub-effusa; marginibus junctis, intus levigatis; labro atque labio valde incrassatis, primo antice lateraliter producto atque dilatato, altero valde calloso, late marginato; columella solida.*

This genus was proposed by Deshayes for the eocene *Melania marginata*, Lamk.,* (*Keil. turricula, Brug.* sp.) and the same author has since described (loc. cit.) from

* Found also in the eocene beds of Sind and the Punjab.

the Paris basin six species of this genus, all that were known to him. Since the commencement of my work on the cretaceous Gastropoda of the Gosau formation, I have been acquainted with two species from these deposits, and noted them in my Revision (p. 22, quoted above); namely, *Keilostoma conicum* et *tabulatum*, Zek. sp. Not having then been in possession of Deshayes' Volume, I also gave a short account of the characteristics of this remarkable genus. At the same time (loc. cit., p. 23), I remarked that *Keilostoma (Rissoa) Winkleri*, Müll. (Monog. Aach. Kreidef., 1851, pt. II, p. 8, pl. 3, fig. 6,) might be identical with *K. conicum*, and I still think that this identification is very probable. Guéranger (Album pal. de la Sarthe, etc., 1867, pl. 10, fig. 13,) gives a figure of a *Eulima Cenomanensis*, which species is evidently a *Keilostoma*, and probably the same which he had previously named *Rissoina Cenomanensis*. No other species, which could positively be referred to this genus, have to my knowledge been since described. But from the South Indian cretaceous deposits I have to add three new forms, *K. substriatum*, *subulatum* and *politum*; thus we have now thirteen species known of *Keilostoma*, six eocene,* and seven middle and upper cretaceous ones; no doubt the number of the species will soon rapidly increase. The largest form as yet known of the genus is the *Keil. tabulatum*, Zek., from the Gosau formation; its total height being about one and a half inch.

I may remark that there are a number of recent species of *Eulima*† known, which have an aperture very much like *Keilostoma*, being oblique, anteriorly sub-effuse, with the inner lip somewhat thickened, and the outer lip anteriorly produced, very much as in *Rissoina*; but none of these *Eulimæ* have the outer lip externally thickened, they are also quite smooth and polished. It is probable that they have to be separated under a new generic name, unless they can be referred to *Bacula*.

1. Keilostoma substriatum, *Stoliczka*, Pl. XX, Fig. 20.

Keil. testa elongato-conica, apice acuminata; anfractibus planiusculis, postice ad suturam abruptis, spiraliter 5 *lineis impressis notatis, (tribus posticis atque duabus anticis); ultimo anfractu ad basin levigato; apertura late-ovata, obliqua, postice anguste subcanaliculata; labio valde incrassato, elevato; labro antice expanso, extus callositate late marginato.*

Spiral angle 30°; sutural angle 13°.
Height of aperture : total of shell ... (considered as 1·00) ... ... 0·34.
Height of penultimate whorl : its width („ „ „) ... ... 0·60.

This species is principally characterized by the abrupt posterior termination of the whorls, and the five spiral lines on each of them; the two anterior ones often

* The references to the figures of the species in the text of Deshayes' Vol. II are not correct, and have to be changed according to those given in the explanation of the plates.

† Mr. G. Nevill collected two species of these *Eulimæ* at Mauritius and at Bourbon. One of them very much resembles in form the *Eul. obesula*, A. Adams.

become obsolete on the last volution. The aperture is much truncated anteriorly, the outer lip strongly expanded in front, and the inner lip narrow, but very thick and elevated.

Locality.—Ninnyoor, in soft, white limestone; not common.

Formation.—Arrialoor group.

2. KEILOSTOMA SUBULATUM, *Stoliczka*, Pl. XX, Fig. 21.

Keil. testa elongato-conica, aciculari; anfractibus planiusculis, suturis impressis junctis, levigatis; apertura ovate dilatata, postice angustissime canaliculata, antice late truncata; labro lateraliter ac antice producto; labio calloso, multo latiore antice quam postice.

Spiral angle 28°; sutural angle 13·5°.
Height of aperture : total of shell ... (considered as 1·00) ... ... 0·28.
Height of penultimate whorl : its width („ „ „) ... ... 0·56.

Shell elongated, spire very gradually pointed; whorls flat, separated by impressed sutures; outer lip more laterally than anteriorly expanded, and the inner lip having anteriorly almost double the width of what it has posteriorly. These characters easily distinguish the species from the former. The differences between the present one and the next species are still more apparent, when we compare the form of the shell and the dimensions of the separate volutions.

Locality.—Near Arrialoor, in yellowish, siliceous sandstone; very rare.

Formation.—Arrialoor group.

3. KEILOSTOMA POLITUM, *Stoliczka*, Pl. XX, Fig. 22.

Keil. testa elongato-turrita, apice aciculata; anfractibus numerosis, subplanis, sutura impressa junctis, primis convexiusculis, paulo mammillatis; omninis levigatis, striis minutissimis incrementi solum notatis; apertura dilatata, postice vix canaliculata; labro extus postice late marginato; labio adnato, antice lato, postice multo tenuiore atque angustiore.

Spiral angle 26°; sutural angle 10°.
Height of aperture : total of shell ... (considered as 1·00) ... ... 0·21.
Height of penultimate whorl : its width („ „ „) ... ... 0·55.

Whorls very numerous, the first somewhat mammillate and slightly convex; the others almost plane, separated by a deep suture, all of them being perfectly smooth. The basis of the last whorl is very little produced and much truncated in front. The aperture is, as usual, broadly ovate, the outer lip being anteriorly expanded, and its exterior thickening being much broader posteriorly than anteriorly; the reverse is, however, the case with the inner lip, which is very thin posteriorly and on the whole, not nearly so much elevated and thickened, as in the two other species.

Locality.—Garudamungalum, in bluish sandstone; the species occurs not uncommonly with *Rissoa Oldhamiana*, n. sp.

Formation.—Trichinopoly group.

XXXVII. *Family,—EULIMIDÆ.*

H. and A. Adams, Genera I, *Eulimidæ*, p. 235, and *Styliferidæ*, p. 238; *Pyramidellidæ*, ex parte, Gray, Guide 1857, p. 57; *id. auctorum.*

The animals of the typical species of this family resemble in many respects those of the *Rissoidæ*. They have a linguiform foot, which is more or less produced in front and posteriorly provided with an operculigerous lobe; being generally well developed, but often unequal on the two sides; the tentacles are subulate, usually not very long, somewhat thickened at the base where the eyes are sessile; the mantle is enclosed, occasionally with a very slight anterior fold; the teeth are generally wanting or rudimentary, in which point, only, they agree with the *Pyramidellidæ* and *Cerithiopsidæ*, so far as our present observations go.

The operculum is generally horny and sub-spiral, and of the same shape as the aperture.

The shells are turreted with a solid or excavated columella; the surface very often smooth; aperture ovate, rounded, sub-effuse and somewhat produced in front, posteriorly narrow and angulated; inner lip thin, without folds or teeth. As compared with the *Rissoidæ*, the shells of the present family may be said in general to differ, by their more elongated spire and the larger number of whorls, which are generally not richly ornamented, but rather smooth and polished.

Taking in consideration the more important characters of the shells, and so far as known also those of the animals, we would propose to distinguish in this family three sub-divisions, namely, *chemnitziinæ*, *eulininæ* and *styliferinæ*. We shall enumerate some of the better known genera according to this division.

In a geological point of view, the study of the *Eulimidæ* is very important. What Forbes said of the *Pyramidellidæ*, namely that they belong more to past ages than to the present epoch, applies equally well to this family.

a. *Sub-family,—CHEMNITZIINÆ.*

This sub-division includes the larger number of the extinct genera. The recent species belonging to it are as yet very defectively known, being mostly shells of very small size.

1. *Aclis*, Lovén, 1846 (H. and A. Adams' Gen. I, p. 234, ex parte; Ann. Mag. Nat. Hist., 1860, VI, p. 118) as restricted for the spirally ribbed species only.

2. *Ebala*, Leach, 1847 (Ann. Mag. Nat. Hist., 1860, VI, p. 119) proposed for the smooth species of *Aclis*.

3. *Dunkeria*, Carp. *(ibidem)* has been proposed for the cancellated species of *Turbonilla*, of which it was first intended to be a sub-genus, but A. Adams is of opinion that its nearest ally is *Aclis*.

4. *Hyala*, H. and A. Adams, 1853, (Gen., I, p. 326,) rather a thin, smooth shell, but the animal agrees very closely with that of *Aclis*. It is doubtful as yet, whether the genus would not be better placed in the sub-family *lacuninæ*.

5. *Vanesia*, A. Adams, 1861 (Ann. Mag. Nat. Hist., VIII, p. 242 and p. 307) has been proposed for two species,—*V. trifasciata* and *V. sulcatina*,— resembling in all their external characters *Melania*, but being true marine shells; both the species are slightly ornamented with decussated transverse and spiral ribbings.

These five genera, so far as at present known, may be considered as the representatives of a very large number of varied fossil shells. They are generally placed in the *Pyramidellidæ*, but when we compare the animals of *Aclis*, *Ebala* and *Hyala* with those of the genera belonging to that family, we find that they want one of the principal characters, namely, the thickened and folded tentacles of the *Pyramidellidæ*; the eyes are also placed nearer to the outer margins than to the middle; the rostrum, the operculigerous lobes and other organs are found to be much more similar to those of the *Rissoidæ*, than to those of the *Pyramidellidæ*. Comparing the shells, we find them deprived of all columellar folds, chiefly differing from *Turbonilla* or *Eulimella* by the less truncated and anteriorly more produced basis of the last volution, having in consequence a more elongated and ovately shaped aperture; the mammillate apex, which is found to be characteristic of many *Pyramidellidæ*, is usually wanting in the species of the present family.

The fossil species resemble in exterior form *Melaniæ*, but they are believed to be marine shells. Though generally very numerous in different deposits, they are on account of their insufficient preservation, still in many respects so doubtfully and imperfectly known, that we cannot pretend to give anything like a complete account of the genera, which have been proposed for them. As I have already mentioned they belong to the oldest known fossils, having probably their maximum in the triassic period. Some of the better known generic names are the following:—

6. *Pasithea*, Lea, 1833, (Contrib., p. 99). The species are considered by Pictet to be generically identical with those of *Chemnitzia*. There are in reality, however, very different forms described by Lea under the name of *Pasithea;* some of them belong unquestionably to *Eulima*, others to *Niso;* one or two could be referred to *Aclis*, and there are only two species, *P. guttula* and *Claibornensis*, (l. cit., p. 104, pl. 4, figs. 86-87), which are distinguished by a very short spire and ventricose last volution. They resemble *Macrocheilus*, but it is possible that Lea's original name can be reserved for these inflated forms, for they are rather more slender and cylindrical than typical species of *Macrocheilus* generally are. Conrad (Check list eoc. foss., Smithson. Miscel. Coll. n. 200, p. 14) refers both the last named species to *Eulima*, which is hardly correct.

7. *Chemnitzia*, D'Orb., 1839. This name, although first proposed for a series of shells belonging to *Elusa*, *Syrnola* and *Turbonilla* of the *Pyramidellidæ*, must be now retained in the sense, as stated in the Paléontologie française terr. Jur., 1850, Vol. II, p. 31. The principal characteristic distinction of the numerous species here figured seems to consist in the broad *posterior insinuation* of the outer lip, corresponding with the curve of the striæ of growth. The smooth species cannot be generically separated from the ribbed ones, if those ribs have the same direction as the striæ. The sharpened margins of the aperture distinguish the smooth forms

from *Ebala*. The species with numerous whorls and straight transverse ribs must be excluded from *Chemnitzia* and referred to *Turbonilla*, *Scala*, *Eglisia*, and others.

7*a*. *Loxonema*, Phillips, 1841, (Palæoz. foss., etc., p. 98). The characters given *(loc. cit.)* by Phillips correspond with those of smooth species of *Chemnitzia*, the whorls, being contracted posteriorly, generally show slight insinuations of the striæ of growth. The author seems, however, to have also referred to this genus species which belong to *Holopella*, *Turbonilla* and others. Unless in *Loxonema* the margins of the aperture are united and internally somewhat thickened, its generic distinction cannot be retained.

8. *Subulites*, Conrad, 1842 (Pal. New York, 1847, I, p. 182), proposed for a smooth shell, resembling a very much elongated *Terebellum*, but the exact form of the aperture is unknown. If this be really rounded and entire in front, the genus must be placed in this sub-family; in the contrary case it may belong either to the PYRAMIDELLIDÆ or to the ALATA.

9. *Polyphemopsis*, Portlock, 1843 (Geol. of Londonderry, etc., p. 415, pl. 31, fig. 2). The original species resembles a smooth *Chemnitzia*, but the surface is perfectly worn off, and unless any peculiarities of better preserved specimens be pointed out, the genus can hardly be considered as of any value for the determination of species.

10. *Holopella*, M'Coy, 1855, (Brit. Pal. foss. II, p. 303,) includes a number of species with remarkably convex whorls, the first of which are often cancellated by transverse and spiral striæ. The species, belonging to this genus, are in some respects intermediate between *Dunkeria* and *Hyala*; they also resemble *Aclis*.

11. *Pseudo-Melania*, Pictet and Camp., 1862 (Mat. p. l. Pal. Suisse, 3me. Ser., p. 266). It is difficult to state precisely in what the differences of this genus consist, as compared with *Chemnitzia*. The few species referred to it by Pictet and Campiche, and myself,* are all smooth shells, like many *Chemnitziæ*, and can only be generically separated from them by their not possessing the characteristic insinuation of the outer lip. Should *Polyphemopsis* be proved to exhibit the same distinction from *Chemnitzia*, Pictet and Campiche's name can be omitted.

The cretaceous species which can, properly speaking, be referred to any of the above named genera, mentioned under numbers 6-11, are only very few.

Pictet and Campiche (loc. cit., pp. 269 and 270,) name a number of species as belonging to *Pseudo-Melania*, but none of them are known in a sufficiently good state of preservation. The *Chem. Pailletteana*, D'Orb., very much recalls by the form of its aperture a *Keilostoma*, but if it has not the outer lip thickened, it may better remain under the generic name of *Chemnitzia*. The *Ch. mosensis*, D'Orb., the only cretaceous species left by Pictet and Campiche (loc. cit., p. 266,) under *Chemnitzia*, is more probably a *Turbonilla*, for it has straight transverse ribs. *Ch. Beyrichi*, Zekeli, is a *Melania*. The *Chem. gloriosa*, Röm., is identical with *Fasciolaria rigida*, Baily (vide p. 109); I have compared the original specimen in the Museum at Bonn. There are also in D'Orbigny's collection in the Jardin des plantes at Paris, three specimens marked *Chem. inflata*; one of them from Uchoux most probably is only an imperfect specimen of *Ampullina bulbiformis*, Sow.; two others from Chattellrouit and Montruhard are very doubtful and imperfect casts. From

* Sitzungsb. Akad., Wien, 1865, LII, Revision, etc., p. 20.

the Senonien a *Chem. bisulcata*, which is properly speaking a *Euchrysalis*, is also in the same collection.

We have to note from Sth. India *Chemnitzia undosa*, Forbes, and two other doubtful species belonging to the same genus, or possibly to *Pseudo-Melania*, [or *Polyphemopsis*].

LXI. CHEMNITZIA, *D'Orbigny*, 1839, (vide p. 284).

1. Chemnitzia undosa, *Sowerby*, *sp.* Pl. XVII, Figs. 19-21.

1846. *Chemnitzia undosa*, Sow., apud Forbes in Trans. Geol. Soc., Lond., VII, p. 125, Pl. XV, Fig. 11.
1847. *Scalaria undata*, D'Orb., Voy. Astrolabe, Paléont., Pl. III, Fig. 31;—*idem* auctorum.

Chem. testa turrita, apice acuminata; anfractibus numerosis, planiusculis, transversaliter costatis, spiraliter minute striatis; costis 16-32 *in uno circuitu, arcuatis, in basi ultimi anfractus obsoletis; apertura ovali, antice sub-effusa; marginibus postice fere junctis; labro tenui, postice ad medium profunde insinuato; labio incrassato, levigato, in terminatione columellari aliquantisper fissuram, vix tectam, exhibente.*

Spiral angle 28°- 30°; sutural angle 10°- 12°.
Height of aperture : total of shell (considered as 1·00) ... ... 0·29.
„ of one whorl : its width („ „ „) ... ... 0·71.

Regularly grown specimens have the whorls generally flattened, except the last one, which being produced at the basis is convex at the periphery. The number of transverse ribs varies from 16-32, and is scarcely in any two specimens exactly the same; all the ribs are posteriorly deeply insinuated, and this alone speaks sufficiently against the determination of the species as a *Scala*, as has been done by D'Orbigny and accepted by subsequent writers; the ribs always disappear on the basis of the last whorl, generally also on the posterior portion near the suture, and even sometimes partially on the previous volution. The surface is besides entirely covered with a dense, but fine, spiral striation.

The aperture is ovate, anteriorly effuse, posteriorly narrow, and with nearly united margins; the outer lip is thin, laminar, and posteriorly above the middle insinuated; the inner lip thick, smooth, and leaves occasionally a narrow fissure exposed.

Localities.—Garudamungalum, Kullygoody, Alundanapooram, Serdamungalum, Anapaudy, Andoor; very common and a characteristic fossil of the

Formation.—Trichinopoly group.

2. Chemnitzia? sp. Pl. XXI, Fig. 1.

Spiral angle 25°; sutural angle 10°.
Approximate height of one whorl : its width (considered as 1·00) ... 0·65.

This is a form somewhat resembling *Eulima Requieniana*, D'Orb. (Pal. franç. crét. II, pl. 155, fig. 18), but it is less cylindrical. Neither the surface of the shell nor the aperture are in our specimen well preserved, and we therefore abstain from

specifically naming this fragment. The striæ of growth appear in one place to show a tendency to be insinuated, and this makes it probable that the species belongs to *Chemnitzia*.

There are also in our collection several fragments of a very large and similarly formed species, found in calcareous sandstone near Moraviatoor, but we are not certain of their identity. The fragments are all too imperfect for specific description.

Locality.—Near Shillagoody, in yellowish siliceous sandstone.

Formation.—Arrialoor group.

3. CHEMNITZIA ? sp. Pl. XXI, Fig. 2.

Spiral angle 35°; sutural angle 6°.
Approximate height of one whorl : its width (considered as 1·00) ... 0·50.

This is another fragmentary specimen, of which the surface and the aperture are likewise not well preserved, but most probably the species belongs to *Chemnitzia*. The basis of the last volution is spirally striated, and the inner lip is of considerable thickness. Its specific distinction from the former is exhibited in the two figures.

Locality.—E. of Anapaudy, in yellowish calcareous sandstone.

Formation.—Trichinopoly group.

b. *Sub-family,—EULIMINÆ.*

(Vide fam. *EULIMIDÆ* in H. and A. Adams' Genera, p. 235).

1. *Eulima*, Risso, 1826, (H. and A. Adams' Gen. I, p. 236).

2. *Leiostraca*, H. and A. Adams, 1853, (Gen. I, p. 237). The white shells of *Eulima* being covered with an enamel coat and generally having the apex irregularly twisted, can easily be distinguished from the recent variegated species of *Leiostraca*, but among fossils it is as yet difficult to ascertain satisfactorily these distinctions.

As regards the cretaceous species of *Eulima* I must be contented to refer to Pictet and Campiche's last review in the Mat. p. l. Pal. Suisse, 3me. Ser., p. 271. I cannot at present hazard the slightest conjecture as to how many of those species will remain in the genus *Eulima*, or have to be transferred to other genera. Of the four species, described by Zekeli from the Gosau-deposits, the *E. turrita* has been referred to *Pseudo-Melania*, and the others belong to *Keilostoma* of the *RISSOIDÆ* (vide Sitzungsb. Akad., Wien, 1865, LII, Revis. etc., p. 20). The *Eulima acuminata*, Müller, is a *Rissoina* (vide p. 280); *Eulima Cenomanensis*, Guéranger, is a *Keilostoma* (vide p. 281); *Eulima amphora*, D'Orb., is a *Euchrysalis*. The *Eulima seminosa*, Gabb, 1860, (Proc. Phil. Acad., p. 197, pl. 3, fig. 6,) is perhaps a true *Eulima*. Prof. Forbes described from Sth. India a *Eul. antiqua*, which will be found mentioned hereafter.

3. *Apicalia*, A. Adams (Mag. Nat. Hist., 1862, IX, p. 295,) only differs from *Eulima* by a more mucronate and distorted apex; the typical species *A. gibba* is from the Japan seas.

4. *Euchrysalis*, Laube, 1866 (Sitzungsb. Akad., Wien, Vol. LIII, Fauna der St. Cassian Schichten, etc., p. 5). I merely quote the name of this genus from an abstract of the paper, as the memoirs, containing the detailed descriptions of the species, have not yet reached Calcutta. The reference, however, to a few well known species, formerly described by Münster and Klipstein from the triassic beds of St. Cassian, shows that the peculiarities of these shells deserve a generic distinction. They differ from *Leiostraca* by *a pupoid form, being attenuated towards each end and thickened in the middle; the last volution is large, but posteriorly much contracted, and the aperture is proportionately very small. The surface is generally smooth; the inner lip somewhat thickened and arcuate, the outer lip sharp, sinuous and not thickened externally.* The genus evidently recalls *Fenella* of the *Rissoidæ*, including shells of a similar form, but provided with sharp, transverse and spiral ribbings. The thickened inner lip also recalls the form of *Bacula*, Adams.

From the jurassic strata species, like *Rissoa lævis* (*Rissoina id*, d'Orb., et auct.), *Phasianella acutiuscula*, Morris and Lycett, and others, may belong to this genus. Besides the two species, *Eulima amphora*, d'Orb., and *Chem. bisulcata*, d'Orb., we are not acquainted with any other cretaceous forms, except one from our South Indian deposits, and this one only differs from the typical triassic and jurassic species by its gigantic dimensions. We shall describe this species under the name of *Euch. gigantea*. There are several tertiary species known, which in general form very much resemble *Euchrysalis*, and of living species I may mention the *Eulima obesula*, Ad., to which I have drawn attention, when speaking of *Keilostoma* (see p. 280).

5. *Putilla*, Adams, 1867 (Proc. Zool. Soc., p. 312); *shell turbinate, solid, pellucid; aperture sub-quadrate, anteriorly sub-effuse, inner lip straight, thickened; columella rimate.*

(?) 6. *Niso*, Risso, 1826 (H. and A. Adams, Gen. I, p. 237). I do not know whether the animal of *Niso* has as yet been observed, but judging from the angular shape of the whorls and the anteriorly produced aperture, it seems to me, that these umbilicated shells will be better classed in a distinct sub-family in the *Pyramidellidæ*, as stated previously on p. 181. A comparison of the animals is, however, necessary before this transfer can be made.

(?) 6 *a*. *Volusia*, A. Adams, 1861 (Ann. Mag. Nat. Hist., Vol. VIII, p. 306,) has been proposed as a sub-genus of the former, and is based on *Niso imbricata*, Sow., which has the whorls transversally ribbed.

(?) 6 *b*. *Iole*, A. Adams, 1860 (Ann. Mag. Nat. Hist., V, p. 300,) resembles *Niso* in form, but has a remarkably thin shell, because it lives in deep-water; the surface is spirally sulcated.

It is likely that some jurassic species, which have also a very thin shell, like *Trochus Cupido*, d'Orb. (Pal. Franç. Terr. Jur., II, pl. 309, and Sitzungsb. Akad., Wien, 1861, Vol. XLIII, p. 174); *Niso Nerea*, Deslongchamps, (Bull. Soc. Linn. Norm., 1860, Vol. V, p. 126), and a few others, may be referrible to this or to the former sub-genus. The only cretaceous species of *Niso* is described from California by Gabb as *N. polita* (Palæon. of Calif. 1864, I, p. 116, pl. 21, fig. 113).

LXII. EULIMA, *Risso*, 1826, vide p. 287.

1. Eulima antiqua, *Forbes*, Pl. XXVIII, Fig. 2.

1846. *Eulima antiqua*, Forbes, Trans. Geol. Soc., Lond., VII, p. 134, Pl. XII, Fig. 17.

Eul. testa elongate-turriculata, levigata, polita; anfractibus numerosis, subconvexis, postice ad suturas paulo constrictis, atque una vel duabus striis sub-obsoletis notatis; basi convexa, producta, spiraliter striata; apertura ovate elongata, angusta

Spiral angle 23°; sutural angle 8°.
Approximate height of aperture : total of shell ... (considered as 1·00) ... 0·30.
„ „ „ penultimate whorl : its width („ „ „) ... 0·87.

Shell rather elongated, composed of numerous whorls, which are perfectly smooth and covered with an enamel coating. The volutions are slightly convex, posteriorly constricted, and below the suture marked with one or two sub-obsolete, impressed lines. The striæ of growth are only imperfectly traceable. The basis of the last whorl is much produced and spirally striated; the aperture comparatively small and narrow.

I have only examined, in the London Geological Society's collection, Prof. Forbes' original specimen, of which I give an enlarged figure. This species appears to be a true *Eulima*, for the shell is distinctly covered with an enamel coating. The considerable height of the whorls and the narrow aperture rather agrees with the genus *Leiostraca*, though I have not been able to trace any lateral varices on the whorls. The apex is broken of, but the uppermost whorls visible seem to have a tendency to bending on one side. The spiral striation of the basis is unusual in species of *Eulima*.

Locality.—Near Pondicherry, in bluish, calcareous sandstone.

Formation.—Valudayur—(or Arrialoor—) group.

LXIII. EUCHRYSALIS, *Laube*, 1866, vide p. 288.

1. Euchrysalis gigantea, *Stoliczka*, Pl. XXI, Figs. 3-5.

1855. *Turritella Renauxiana*, Baily, Quart. Jour. Geol. Soc., Lond., XI, p. 458,—non *idem* D'Orbigny.

Euch. testa ovate-elongata, apice acuminata, antice subobtusa; anfractibus 9-10, *sub-levigatis, in junioribus spiraliter obsolete striatis, paululum convexis; suturis adpressis; striis incrementi S-forme arcuatis, in intervallis nonnullis sulcis angustis, transversalibus, lente sinuatis notatis; ultimo anfractu maximo, cylindraceo; apertura ovata, postice valde angustata, antice rotundata; labio calloso, arcuato; labro acuto.*

Spiral angle at the apex about 55°; sutural angle 5°- 8°.
Height of last whorl : total of shell ... (considered as 1·00) ... 0·59.
„ „ penultimate whorl : height of spire („ „ „) ... 0·39.
„ „ „ „ : its width ... („ „ „) ... 0·53.

This species is readily distinguished by its very characteristic form, being ovately elongated, pointed at the apex, subcylindrical in the middle, and again

anteriorly somewhat narrower. The whorls are 9 or 10, being slightly convex and in young specimens obsoletely spirally striated; in older ones they are smooth, the striæ of growth are curved in S-form, and at short intervals there are occasionally somewhat deeper sulcations perceptible, instead of varices as is usually the case in recent *Eulimæ*. The aperture was ovate, posteriorly very narrow, anteriorly roundish, as shown by an outline in our Fig. 4. The outer margin is thin, sharp at its edge, and according to the striæ of growth laterally somewhat produced; the inner lip thick, without any fold or teeth, and strongly arcuated; the columella solid.

I was surprised to find in the London Geol. Soc. Collection from the cretaceous rocks of South Africa, imperfect specimens of this species determined by Mr. Baily as *Turr. Renauxiana*, d'Orb.

Localities.—N. of Alundanapooram, E. of Anapaudy, and near Comarapolliam, in coarse, siliceous sandstone; not common.

Formations.—Trichinopoly – and Arrialoor – groups. The mineralogical character of the rock from the two first named localities, which according to Blanford's map refer to the Trichinopoly group, is very similar to that of the last locality, certainly belonging to the Arrialoor group; and it may be possible that the beds, from which the fossils had been extracted in the two former localities, also belong to the same group.

c. *Sub-family*,—*STILIFERINÆ*.

(*Styliferidæ*, H. and A. Adams, Gen. I, p. 238).

The animal of *Stilifer* in general very much resembles that of *Eulima*, except that its foot is anteriorly much more produced, tongue-shaped, forming in some respects a transition to that of the *Naticidæ*. Jeffreys published several very valuable observations on the animal of *Stilifer*. He agrees with H. and A. Adams in the formation of a separate family, but leaves its place undecided (vide Ann. Mag. Nat. Hist., 1864, XIV, p. 321).

The shells differ from those of the *eulimin*æ by a greater globosity of the whorls, and they also are generally thinner. The following genera constitute the sub-family:—

1. *Macronalia*, A. Adams, 1860 (Ann. Mag. Nat. Hist., V, p. 301,) is stated to be a middle-form between *Leiostraca* and *Stilifer*. It lives parasitic on different species of *Echinidæ*.

2. *Stilifer*, Broderip, 1832 (H. and A. Adams' Gen. I, p. 239). *Stiliferina*, A. Adams, 1860 (Ann. Mag. Nat. Hist., VI, p. 335,) is stated to be a form allied to *Stilifer* and *Entoconcha*. The aperture is, however, rather angular, while in *Stilifer* it is always roundish; it seems therefore more correct to place *Stiliferina* in the *litiopin*æ of the family *Planaxidæ*.

3. *Entoconcha*, Müller, 1852 (Gray's Guide, 1857, p. 62; H. and A. Adams' Gen. II, p. 622).

4. *Macrocheilus*, Phillips, 1841 (Pal. foss., etc., p. 103). Only those species, which have an elongated spire composed of numerous, convex and smooth

volutions, ought to be retained in this genus; others with flattened and more cylindrical whorls and with the spire short chiefly belong to *Amaura*, *Amauropsis*, *Littorina*, and others.

4*a*. *Amaurella*, A. Adams, 1867 (Proc. Zool. Soc., p. 311). *Shell small, ovate, white, apex submammillate; aperture ovate, inner lip arcuate, simple, somewhat thickened, columella solid.* The type of this genus is the species formerly described from the Japan seas, by the same author, as *Macrocheilus japonicus*. In describing this species in the Ann. Mag. Nat. Hist. of 1860, V, p. 407, A. Adams stated, that no generic distinction exists between the fossil species and the recent one which he had discovered. I must say, that I cannot consider the characteristics given of *Amaurella* as in any way different from those of *Macrocheilus*, at least not in the sense in which I believe this last genus has any claim to be accepted by conchologists.

I am not acquainted with any cretaceous species of the *Stilifer*inæ, but I have already (p. 284) mentioned, that certain tertiary species, described by Lea under the name of *Pasithea*, in form much resemble *Macrocheilus*.

XXXVIII. *Family,—NATICIDÆ.*

The animals of the *Naticidæ* are especially characterised by the very considerable expansion of the fleshy foot, which is sometimes longitudinally folded in front, enveloping the shell to a greater or lesser degree; the head is small, the tentacles conically elongated, united by a veil at their base; eyes very small, generally immersed in the fleshy substance, and placed above on short peduncles at the outer base of the tentacles, they are said to be occasionally altogether wanting; the mantle is enclosed and the operculigerous lobes generally well developed. The proboscis is elongated and entirely retractile; the teeth are arranged in seven series, the central ones being broad, with 3-5 unequal, internally curved processes, while the lateral teeth are elongated, at the tips more or less hooked or denticulated. The gills are said to consist of two united plumes and some mucous fillets.

The *Naticidæ* belong to the most predaceous Mollusca, especially burrowing in sand after bivalves, the shells of which they drill with their armed tongue, extracting the soft parts of the animal through the perforation. Some of them, according to the examinations of Prof. Troschel, possess a peculiar fleshy disc for the purpose of attaching themselves to those shells, which they intend to attack.

The operculum is usually paucispiral, horny, sometimes covered with a shelly layer. H. and A. Adams state that it does not often correspond in size with the aperture, as those species which have the latter large often possess a small operculum, and on the contrary those with a narrow aperture, a comparatively large one. In young specimens the operculum is generally of the same size as the aperture.

The shell is spiral, more or less globose, with a short spire and the last volution inflated, or more or less enlarged; the surface smooth, polished or spirally sulcated; the aperture oval or hemispherical, generally obliquely prolonged, large, anteriorly rounded, posteriorly angular, and often sub-canaliculated, anteriorly broadly rounded, entire.

H. and A. Adams quote under the *Naticidæ* a number of genera, which with a few alterations and additions may be adopted. Some of the old names which they introduce are probably less liable to be mistaken, than many of the newer ones. Where their priority is doubtful or incorrectly stated they of course should be replaced by others which have an acknowledged priority. Gray (Cat., 1857, p. 47,) distinguishes in the family four divisions, two of which he calls *naticina* and *neveritina*, and of the two others, one includes *Cervina* (= *Ampullina* apud H. and A. Adams), and *Naticina;* the other *Stomatia* (= *Sigaretus*, auctorum) and *Amaura*. It is really very difficult to retain these divisions, for they are chiefly based upon such very slight variations in the form of the shell, that it is impossible to trace them out. More practical advantage could probably be derived from a division, similar to that accepted by Chenu in his Manuel de Conchyliologie, in which the author distinguishes only two genera, *Natica* and *Sigaretus*. These divisions may be admitted as sub-families, *naticinæ* and *sigaretinæ;* the former would then include all the smooth, the latter all the spirally striated species, each with a number of certain characteristic generic forms. To these two divisions we now add as a third one the cretaceous *Tylostomæ*.

a. *Sub-family,—TYLOSTOMINÆ.*

Shell elongated, turreted, naticoid, with internal varices; columella solid or slightly excavated.

Tylostoma, Sharpe, 1849; (*Varigera*, d'Orbigny, 1850).

Char. *Tyl. testa conoideo-turritellari, ovata seu sub-globosa; ultimo anfractu inflato, superficie levi interdumque polita; anfractibus ad intervalla varicibus internis instructis; apertura ovali, postice acuta, antice angustata atque sub-effusa; labio atque labro intus incrassatis; labro ad marginem paulo dilatato atque acuto.* (Vide Pl. XXVIII, Fig. 3).

Since the publication of my opinions as to the presumed identity of *Pterodonta* and *Tylostoma* (*vide* pp. 35-41), I have had an opportunity of examining nearly all the principal collections of Europe, and found that the genus *Tylostoma*, as instituted by Sharpe, must be retained. My present definition and classification of the genus is based upon two well preserved specimens of *Tyl. (Pter.) naticoides*, D'Orb., from Uchoux. These two specimens exist in D'Orbigny's collection (étage Turonien), in the palæontological Museum of the Jardin des Plantes at Paris. On Plate XXVIII, Fig. 3, is given an approximately correct view of one of these specimens, with the special object of demonstrating the shape of the aperture, which in this specimen is perfectly preserved. It can be seen from this figure, that both the margins of the aperture are internally strongly thickened, considerably projecting into its space and thus causing a great contraction, while the extreme outer margin expands a little and forms a sharp edge. The anterior termination of the aperture is much narrowed, and on the margin slightly indented, as in *Actæonella* or *Ampullaria*, but not in any way emarginated. The strong thickening of the inner

lip of *Tyl. naticoides* is not a generic character, for we have often seen it in other species not more callous, as for instance in *Amp. sortita*, (see figures of the species on Pl. V).

All these characters, combined with the strong and smooth shell, are not opposed to the classification of this genus in the *Naticidæ*, but on account of the internally thickened outer margin, we would suggest to distinguish these shells as a separate sub-family. There is no other family in which they could be better placed, as already correctly pointed out by Sharpe, D'Orbigny, Morris, a. oth. The internal varices are not always present on the upper whorls (as stated on p. 37), and in such cases the distinction between imperfect specimens of *Tylostoma* and *Ampullina* or *Euspira* is extremely difficult, or sometimes actually impossible. When the internal varix of the outer lip is toothed or crenulated, no better comparison can be made, than that between the shape of the aperture of *Tylostoma* and that of *Scarabus*, Montf. *(vide* p. 35). The peculiarly punctated surface of the shell in some of the species, is quite similar to that of many other *Naticidæ*, smooth species of *Alata*, and others.

With reference to the structure and other characters of the shell of *Tylostoma*, I must direct the reader to my previous observations on pp. 35-41. I have only to state what I at the present consider to be the distinctions of *Pterodonta* from *Tylostoma*, and in what way the large number of known species ought to be classified.

First I may remark, that D'Orbigny's *Varigera*, (of which I said, p. 35, that the author's generic characteristics were not clearly defined), is unquestionably identical with *Tylostoma*. D'Orbigny makes reference to external varices, and these are indeed sometimes present, as I previously suspected, (see note on p. 35). They are produced by the remains of the somewhat dilated margin of the outer lip, as the shell grows larger. Generally, though not constantly, these varices are opposite, being distant half a whorl from each other. In many species there is, however, not a trace of them to be found, and therefore their appearance cannot be considered as of generic value.

Sharpe's original specimens of *Tylostoma* are now in the collection of the Geol. Society of London; they all belong to that genus, though many of them are very imperfect.

D'Orbigny made no correct distinction between his *Pterodonta* and his *Varigera*, either in the Paléont. française, or in the Prodrome. Of the three species, described by that author in the former publication, *Pt. inflata* must most probably be transferred to *Tylostoma;* the two others belong to *Pterodonta*. The *Pt. naticoides* is certainly a typical *Tylostoma*, but all the other species of D'Orbigny's *Pterodonta* and *Varigera* are represented in his collection by such very indistinct casts, that I would not venture to pronounce anything certain even with regard to their generic, much less with regard to their specific determination. Most of the species described by Pictet and Coquand correctly belong to *Tylostoma*.

In addition to the species previously (p. 40) noticed, I have to mention *Tylost. lineatum*, Eichwald (Leth. Rossica, XI, Livr., 1867, p. 823, pl. 28, fig. 10) which in form resembles our *Tylost. bulimoides;* the former species is stated to occur in the Neocomien of Antonowo on the mouth of the Oka river. The same author besides quotes from other localities of Russia *Tylost. Rochatianum*, *T. Laharpi* and *T. depressum*, all previously described by Pictet and Campiche in the third series of the 'Materieaux pour la Paléontologie Suisse.'

The name *Pterodonta* has to be retained for species, of which the *Pter. elongata*, d'Orb., is the type, having a *distinctly dilated outer lip, provided with an internal tooth and a more or less produced, or recurved, anterior canal.* The species agree in form with some *Strombi*, like *St. Lamarckii*, but they usually appear to have a smooth shell. *Pterodonta ovata* would also be a species of this genus. How far the other species noted by D'Orbigny in his 'Prodrome' are true *Pterodontæ*, I have, as already stated, not been able to ascertain on account of the very defective state of the original specimens.

What I have previously (pp. 39, 40, and 41) called *typical species* of *Pterodonta* are mostly true *Tylostomæ*, while on the contrary those few species, like *Pt. gaultina* and *carinella* of Pictet, and my *Pt. terebralis*, may possibly belong to *Pterodonta*. Pictet himself is not certain of the correctness of the generic determination of his two species; two others described by Seeley (vide p. 39) are also doubtfully distinct from *Aporrhais*, and the same may be said regarding my generic determination of *Pt. terebralis*. I should not be surprised, if the last named species proves to belong to the PYRAMIDELLIDÆ or to the CERITHIIDÆ.

Thus after all the numerous suggestions and alterations, which I have formerly proposed in the genus *Pterodonta*, it now appears that most of the species have again to be restored to *Tylostoma*, which most probably belongs to the family NATICIDÆ. I do not know a single genus of recent shells, which can be closely compared with the cretaceous *Tylostomæ*, though internal varices are found in some species of PYRAMIDELLIDÆ, CERITHIIDÆ, ALATA, and in a few others.

b. *Sub-family,—NATICINÆ.*

1. *Amaura*, Möller, 1842, (H. and A. Adams' Gen. I, p. 213,) has been restricted only to the turreted species, like *A. candida*, Möll., from Greenland. With regard to its form this species may be considered as intermediate between the NATICIDÆ and the CHEMNITZIINÆ (family EULIMIDÆ).

2. *Amauropsis*, Mörch, 1857, (H. and A. Adams' Gen. II, p. 621), has been proposed for the two northern species, *A. canaliculata* and *A. cornea*, the shells of which merely differ from *Amaura* by their more ovate and ventricose form. The spiral striation which is occasionally present is only superficial, and easily worn off. There is a large number of fossil species known, which as regards the form of their shells are not distinguishable from *Amauropsis*. These are thinner than those of *Ampullina* or *Euspira*, by which character alone they often can be distinguished from these allied genera. The two living representatives are inhabitants of the northern

seas, nevertheless there is no direct proof*, that similar forms were formerly not inhabiting warmer seas, and as there are still large unexplored areas, other species may be found living somewhere at a great depth. We have in *Amauropsis* a similar case to that which we have mentioned in *Trichotropis*, of which, however, several tropical species have already been discovered.

The species from cretaceous rocks are not numerous. I may mention *A. paludinæformis*, Meek and Hayden, (Mem. Acad. Boston, V, p. 389, pl. 3, fig. 3), *A. oviformis*, Gabb, and *A. alveata*, Con. sp. (Pal. Calif. 1864, I, pp. 109-110). In my revision of the Gosau-Gastropoda (Sitz. Akad., Wien, 1865, LII, p. 44,) I have referred *Natica acuminata*, Reuss, *to Amaura*, which ought to stand as *Amauropsis acuminata*, being very closely allied to the recent species, *A. canaliculata*. Other species are *Nat. Cassisiana*, d.Orb., perhaps *N. Clementina*, d'Orb., and also *Nat. vulgaris*, Reuss. The *Turbo conicus*, Sow., (Min. Conch. V, p. 45, pl. 433, fig. 1; *Natica sub-conica*, d'Orb., Prod. II, p. 150), is also an *Amauropsis*. I have lately examined Sowerby's original in the British Museum, and found the specimen spirally striated. This species ought then to stand as *A. conica*, Sow. sp. We have to note from South India *A. pannucea*, n. sp.

3. *Ptychostoma*, Laube, 1866, (Sitz. Akad., Wien, Vol. LIII; Fauna der St. Cassian Schichten, p. 3), has a shell like *Amauropsis*, but apparently with a twisted inner lip. There are three species referred to it by Laube, *Pty. pleurotomoide*, and *Pty. sanctæ crucis* of Wissmann, and *Pty. gracile*, Laube; they are all from the triassic beds of St. Cassian.

4. *Ampullina*, Lamck., 1813 ?; (H. and A. Adams, Gen. I, p. 208). There is only a single recent species, *A. fluctuata*, Sow., as yet known, but the genus appears to have a very large number of representatives in the mesozoic and palæozoic formations. The *shell is characterised by the ventricose form of the last volution and a thick inner lip, either leaving a slight fissure exposed at the termination of the columella, or more frequently covering the entire central portion of the basis.* Many of them very much resemble in their form some species of *Ampullaria* and also of *Euspira*, but they are readily distinguished from them by a greatly thickened inner lip, which is closely attached to the shell. The spire is pointed and more or less elevated, but seems to vary very considerably, even within the limits of one and the same species (vide Plate XXI, Figs. 11-15).

I have already in my revision of the Gastropoda of the Gosau formation (Sitzungsb. Akad., Wien, 1865, LII, p. 43,) placed the *Natica bulbiformis*, Sow., in this genus. The very same species is also found in South India, and besides this another very characteristic new species, *Amp. sortita*, has been found in the upper beds of the cretaceous deposits at Ninnyoor. Other cretaceous species of the same genus are *N. mastoidea*, P. and Camp. (Mater. p. l. Pal. Suisse, 3me. Ser., pl. 76, figs. 2-3); *N. bulimoides*, d'Orb., *N. Requieniana*, d'Orb., (if distinct from *N. bulbiformis* in Pal. franç. terr. crét.), and probably many more, which at present are known only from casts.

4*a*. *Naticopsis*, M'Coy, 1844, (Synop. carb. foss., Ireland, 1862, p. 33). The typical specimens of this genus only appear to differ from the former by a somewhat shorter spire; some of the species, however, which were subsequently described under the same generic name, are actually not to be distinguished from *Ampullina*.

* A recent species was found by A. Adams in the Japan sea.

[*Naticodon*, Ryckholt, 1847, (?) (Mél. Pal. pt. I, 1852, p. 75), has been proposed for a number of species similar to *Ampullina*, but provided with a tooth on the inner lip. The genus, as restricted, may better be placed in the *Vanikoridæ*, though there have also been species described under the name of *Naticodon*, which do not appear to possess a columellar tooth, and in such cases they hardly can be distinguished from *Ampullina*. Deshayes, confirming Raulin's suppositions (Anim. s. vert. foss. de Paris, 2nd edit., Vol. III, p. 83), retains also *Deshayesia* in the family *Naticidæ*; I shall, however, subsequently state my reasons for classifying the same in the family *Neritidæ*].

There are further a number of cretaceous species, like *Nat. carinata*, Röm. (Nordd. Kreidegeb. 1841, p. 83, (*Nat. unicarinata*, Geinitz, Char., 1842, p. 74), *Nat. Valdensis*, Pict. and Camp. (Mat. Pal. Suisse, 3me. Ser., pl. 74, fig. 4), and others, which have a raised ridge placed in or about the middle of the last volution. It is very probable that this ridge terminates on the outer lip with a narrow emargination or notch, somewhat similar to that known in *Neritoma*, Morris, *(Neritidæ)*; but as none of the above mentioned species have been found in a well preserved state, it is impossible to form a correct idea of their relations to that fossil genus.

5. *Ampullinopsis*, Conrad, (Smithson. Miscel. Coll., No. 200, Check list invert. eocene foss., 1866, p. 20,) with the species *Am. Mississipensis*, Con.; we are as yet only in possession of the name.

6. *Euspira*, Agassiz, 1837, (Sowerby, Min. Conch., Germ. edit., p. 14, and p. 320). *Lunatia*, Lamarck? apud H. and A. Adams, Gen. I, p. 206; *idem* Gray, 1847, Proceed. Zool. Soc., Lond., p. 149. The species referred to this genus are distinguished by a regularly conical spire, resembling that of *Amaura* and *Amauropsis*, a moderately callous inner lip and a slightly excavated columella; the last volution is inflated in proportion to the previous whorls. The recent forms are mostly unicoloured and especially numerous in the eastern seas, though not so common as species belonging to several other genera of the *Naticidæ, (Natica* and *Mamma)*. H. and A. Adams (Gen. I, p. 207,) accept the genus in the same sense, as pointed out by Agassiz, under the name of *Lunatia*, for which they quote Lamarck's authority. We have not been able to procure Lamarck's reference, but Gray used the name first in 1847. Swainson proposed in 1840 for the species of *Euspira* the name *Globularia*. Neither of these names of Gray and Swainson can have priority before that of Agassiz. H. and A. Adams quote the name *Euspira* as a synonym of *Ampullina*, which is not correct.

The same authors (l. cit., p. 207,) proposed for *Nat. flava*, Gould, from Massachusetts Bay, the sub-generic name *Acrybia;* but as the shell of this species is thin, and the columella almost solid, it would probably be better to transfer it to *Amauropsis*, with which also the plain and uniform colouring agrees.

A very large number of fossil species, usually described under the name of *Natica*, belong to the genus *Euspira;* and some of the older (especially triassic) forms often resemble species of *Macrocheilus* and *Stilifer*, though they always have a thicker shell.

The cretaceous species of *Euspira* are not yet discriminated, though tolerably numerous. In addition to the species noted as *Lunatia* in Meek's Check. list of jur. and cretaceous foss., North Am.,

1864, p. 20, and those described by Gabb in the Pal. of Calif., 1864, I, p. 105, etc., under the same generic name, we may mention a number of European cretaceous species, like *N. ervyna*, d'Orb., *N. Matheroniana*, d'Orb., *N. Rhodani*, Pict. et Roux, and others. We shall give descriptions of the following six species from our cretaceous beds of S. India; *Euspira pagoda*, Forbes; *Eu. Indrana*, Stol.; *Eu. rotundata*, Sow.; *Eu. spissata*, Stol.; *Eu. lirata*, Sow.; and *Eu. Mariæ*, d'Orb. Some of these species, like *Eusp. pagoda* and others, are distinguished from others of the same genus by a somewhat higher spire, which is specially prominent in young specimens, but this cannot be considered as of any great importance. Comparing, for instance, the recent *Eusp. duplicata* with our *Eusp. spissata*, the difference in the height of the spire is almost trifling.

7. *Gyrodes*, Conrad, 1860, (Jour. Acad. Nat. Sci. Phil., 2 Ser., IV, p. 289,) was first considered as a sub-genus of *Natica*, but subsequent researches have shown that it has been based on distinctions, not less characteristic than those of many other new genera. The characters of *Gyrodes* are stated principally to consist in the *globosity and thin structure of the shell, in the whorls being posteriorly flattened or canaliculated, and in the umbilicus being largely exposed, without any callosity on the columella or on the basis of the last whorl.*

If we were not in possession of large and apparently full grown specimens, we should have been very much inclined to consider the species of *Gyrodes* as *Neverita* in a young state, but with our present materials we believe the characters, above quoted, possess a generic value. The posterior flattening or canaliculation of the whorls is common to species of several other genera, and has therefore only relatively any importance. But the depressed or sub-globose form of the thin shell, the large umbilicus which often has in young specimens a crenulated, and always a more or less angular, peripherical edge, and lastly the want of a callosity on the inner lip, appear to be good characters of this genus. We do not know whether any living species of *Natica* belong to it. Tertiary species are also not very numerous, and the cretaceous have as yet to be selected out of the large number of known species of *Natica*.

Meek quotes in his Check-list of invert. foss., etc., (1864, p. 21,) six species, to which has to be added the *Gyr. expansus*, Gabb. (Pal. Calif. 1864, I, p. 108). European species like *Nat. excavata*, Mich., *Nat. truncata*, Pict. et Roux, and others appear also to belong to *Gyrodes*. We shall describe from S. India *Gyr. pansus* and *Gyr. tenellus*.

8. *Neverita*, Risso, 1826, (H. and A. Adams, Gen. I, p. 208,) only differs from the former genus by the callous and twisted columella. The only cretaceous species as yet known is described by Gabb in the Pal. of Calif., 1864, I, p. 108, as *Nev. secta*.

9. *Mammilla*, Schum., 1817, (*Ruma*, Chemnitz., H. and A. Adams, Gen. I, p. 209,) is allied to *Gyrodes*, but has a thick shell and the spire very short and pointed, the inner lip more thickened, and the volutions posteriorly not canaliculated or flattened. Gray in his catalogue of 1857, p. 49, retains Schumacher's name *Mammilla*, and correctly quotes (in his list, etc., of 1847, p. 149,) *Naticaria*, Swains., as a synonym, while H. and A. Adams refer this last name to *Neverita*. They also accept for the genus the name *Ruma*, but I have been unable to procure any reference to the publication of this name.

There are only a few tertiary species of *Mammilla* known, and also only very few from cretaceous deposits, like *Nat. Pidanceti*, Coqu. sp. (Pictet et Camp. Mat. Pal. Suisse, 3me. Ser., pl. 76, fig. 1),

and others. Two as yet undescribed species have been found in our S. Indian cretaceous deposits, *Mamm. edura* and *carnatica*.

10. *Mamma*, Klein, 1753, (Ostrac., p. 21,—H. and A. Adams, Gen. I, p. 210,) merely differs from *Mammilla* by its twisted columella, which forms a thickened string in the narrow umbilicus. The species which appear to belong to this genus have not yet been separated from *Natica;* they are rather rare shells.

Naticina, Gray, 1842 (H. and A. Adams, Gen. I, p. 211,) will be mentioned in the family *Velutinidæ*.

c. *Sub-family*,—*SIGARETINÆ*.

1. *Lupia*, Conrad, (Smithson. Misc. Coll. No. 200, Check-list eocene foss., 1866, p. 15,) with the species *L. perovata*, Con.

2. *Sigaretus*, Lam., 1799 (*Stomatia*, Hill, 1752;—*Catinus*, Klein, in H. and A. Adams' Gen. I, p. 212). Hill's name *Stomatia* would have priority, if it were perfectly reliable (*vide* also Gray's Cat. 1857, p. 50). H. and A. Adams accept the name *Catinus*, but besides this name forming only a part of the generic denomination '*Catinus lactis*' used by Klein (*vide* Ostrac., p. 19,) there appears some doubt whether that shell is really a *Sigaretus* in Lamarck's sense, for Klein calls the shell smooth; in such a case this would be as well applicable to *Stomatia* of Helbling, or to a *Stomatella*.

Römer (Nordd. Kreidegeb., 1841, p. 83,) says of *Nat. acutimargo* that it possesses 'concentric striæ.' If this is really the case the species may prove to be a *Sigaretus*, although the shell is much more like a *Gyrodes*. Guéranger (Essai d'une repert. Pal., etc., 1853, p. 30,) mentioning a *Sigaretus bicarinatus*, leaves it doubtful whether the species correctly belongs to that genus. From the reference to certain keels and a band between them it would not appear very probable, that the shell is a *Sigaretus*. The figure given in his Album paléont., etc., 1867, pl. 10, fig. 8, gives, however, a better idea of the species; it is here evidently entered under the name of *Stomatia bicarinata*.

The list of cretaceous species of the *Naticidæ*, as reported in Pictet's Mat. p. l. Pal. Suisse, 3me. Ser., pp. 391-399, and in Gabb's Cat. of cret. fossils, is already very considerable, and still several species have since been added to that number. We have already stated the difficulty, which would necessarily follow any attempt at a generic determination of them, for a large number are only known from imperfect specimens. Besides many of the species themselves are by no means certain or correctly determined. Those of the Alpine Gosau-formation will be found re-examined in my revision of the Gosau-Gastropoda, p. 43, etc. (Sitzungsb. Akad., Wien, 1865, LII). Additional new species have been described, since Pictet's publication of the 3me. Ser. of the Mat. Pal. Suisse, in Coquand's 'Geol. and Pal. de la Constantine' and 'Étage Aptien de l'Espagne', in Binkhorst's 'Monograph Gast. et Ceph. de la craie de Limbourg,' in Gabb's Pal. of California, 1864, Vol. I; in Guéranger's Album Paléont. de la Sarthe, etc., 1867; Eichwald, Lethæa Rossica, XI. Livr. 1867, pp. 808-821, and others. The thirteen species

from the South Indian cretaceous rocks will be found noted subsequently; they belong, as already stated, to five genera, namely, *Amauropsis*, *Ampullina*, *Euspira*, *Gyrodes*, *and Mammilla*.

Thus the total number of all the known and well characterized cretaceous species amounts to more than one hundred. This number, however, does not represent the complete fauna of *Naticidæ* during the cretaceous period, and still the known recent species scarcely exceed it by more than an additional half. This clearly shows how much more numerous the *Naticidæ* were in former times, than they are at present. Representatives of the family are to be found in the lowest fossiliferous deposits, and they attain very great importance as early as the carboniferous period. They are found in the greatest variety in the lower secondary deposits, though not much more in the triassic than in the jurassic period. The older species chiefly belong to the genera *Amauropsis*, *Ampullina* and *Euspira*, usually possessing a regularly conical spire and the columella solid or slightly excavated; the tertiary species, however, approach much nearer to the living forms, mostly belonging to the genus *Natica* proper. They are widely distributed, though certainly more numerously represented in tropical, than in temperate seas.

Viewing in general the characters of the cretaceous *Naticidæ*, it is remarkable that there are among them so very few species of real *Natica*, the species of which have a wide umbilicus and a distinctly twisted columella. Most of the cretaceous forms belong on the contrary to *Amauropsis*, *Ampullina* or *Euspira*, and the depressed forms to *Gyrodes* which has the inner lip less thickened. Species of *Neverita*, *Mammilla* and others are comparatively rare.

LXIV. AMAUROPSIS, *Mörch*, 1857.

1. Amauropsis pannucea, *Stoliczka*, Pl. XXI, Fig. 10; Pl. XXII, Fig. 1.

Amaurop. testa ovato-elongata, spira turrita, acuminata; anfractibus circiter septenis, convexis postice ad suturam truncatis seu sub-canaliculatis; ultimo spira altiore; superficie in junioribus speciminibus spiraliter minute striata, in ætate adulta sub-levigata; apertura elongate semilunari, obliqua, postice acuta, antice rotundata, labro tenui, ad marginem acuto, labio paulo incrassato, arcuato; columella rimata, in adultis speciminibus ad basin callositate labii tecta.

Spiral angle 70°-75°; sutural angle 6°.
Height of aperture : total of shell (considered as 1·00) ... 0·63.

An ovate shell, consisting of about seven volutions, the last of which is inflated and higher than the spire. The sutures are deep, each of the whorls being posteriorly somewhat flattened, or slightly canaliculated. The aperture is oblique, semilunar, with a thin outer lip, the inner lip being moderately thickened. Young specimens have a distinct fissure at the basis, but in old ones the end of the columella is occasionally quite covered by the expansion of the inner lip (Pl. XXI, Fig. 10). The surface is spirally minutely striated, though in large specimens the striæ often become obliterated, or at least much less distinct.

This species differs from *Amaurop. alveata*, Con. (Gabb in Pal. Calif., 1864, I, p. 110, pl. 19, fig. 59, and pl. 21, fig. 111,) by its more slender form, and posteriorly less broadly flattened volutions.

Localities.—Near Karapaudy, N. E. of Andoor, E. of Anapaudy; not common.

Formation.—Arrialoor – and Trichinopoly – groups; to the former only the first named locality refers, but the species is here more common than at the two others.

LXV. AMPULLINA, *Lamarck*, 1813.

1. Ampullina bulbiformis, *Sowerby*, sp. Pl. XXI, Figs. 11–15.

1836. *Natica bulbiformis*, Sow., Trans. Geol. Soc., Lond., III, p. 418, Pl. XXXVIII, Fig. 13.
1865. *Ampullina id.* ... , Stoliczka, in Sitz. Akad., Wien, LII, Revision, etc., p. 43,—with references to previous publications on the European forms.

Amp. testa ovata, spira plus minusve elevata; anfractibus subconvexis, aliquantisper in speciminibus adultis paulo concavis, postice ad suturam truncatis seu canaliculatis, ultimo ad medium convexo aut subangulato aut gibboso, interdumque cylindraceo; superficie semper striis incrementi minutis notata, in junioribus spiraliter punctata, aliquantisper sulcis distantibus spiralibus, subobsoletis tecta; apertura ovali, antice rotundata, postice acuminata, labio crassissimo, fissuram columellarem sæpissime tegente.

Spiral angle varying from 65°-105°; sutural angle 5°-6°.
Height of aperture : total of shell (considered as 1·00) ... 0·60–0·80.

I have already in my Revision of the Alpine Gosau-Gastropoda referred to the very considerable variations, to which this species is subject with regard to the height of the spire; this being in some specimens more, in others much less elevated. The principal characters distinguishing it are, the broad posterior flattening or canaliculation of the whorls and the very great thickness of the inner lip. Well preserved and fully grown specimens do not even, in consequence of the callosity of the inner lip, show any fissure at the termination of the columella, it being only occasionally traceable in those specimens, which have the last volution strongly inflated. The same specimens also usually have the posterior edge of the whorls more distinctly canaliculated, while others have it only flattened. The striæ of growth are always distinct; but the punctuation which is arranged in distant, spiral lines, is generally only clearly traceable in the smaller specimens, though not always altogether wanting in the large ones. Sometimes specimens are found which exhibit, on the surface of the last volution, more or less regular and distant spiral ridges.

Localities.—Near Kolakonuttom and Moraviatoor, (Oot. gp.); Alundanapooram, Garudamungalum, Anapaudy, Andoor, etc., (Trich. gp.); near Comarapolliam, (Arrial. gp.). At all the localities, except the last one, the species is very common, especially in the Ootatoor beds near Kolakonuttom (vide Mem. Geol. Surv., Vol. IV, pt. I, p. 88, etc.), wherefrom it is quoted by Mr. H. Blanford under the name of *N. pagoda*, Forbes; it is to be met with not less common in the Trichinopoly beds near Anapaudy and Garudamungalum.

In Europe likewise *Amp. bulbiformis* is one of the most common species all through the Alpine upper cretaceous deposits, and also in S. W. France, in Hungary and in Transylvania. I also found among the cretaceous shells, brought from Texas by Prof. F. Römer and presented to the Museum in Bonn, two casts which most probably belong to this species.

Formations.—Ootatoor –, Trichinopoly – and Arrialoor – groups.

2. Ampullina sortita, *Stoliczka*, Pl. XXIII, Figs. 2-3.

Amp. testa globosa, levigata, spira brevi, acuminata, vix tertiam partem totius altitudinis occupante; anfractibus convexiusculis, ultimo valde inflato, convexo; apertura semilunari, labio crasso, calloso, fissuram columellarem tegente.

Spiral angle 90°- 95°; sutural angle 8°.
Height of aperture : total of shell ... ... (considered as 1·00) about 0·70.
Approximate height of last whorl : its width („ „ „) „ 0·75.
Largest specimen measuring 80 mm. in height and about 70 mm. in width.

This species is distinguished by the great size of the last volution and the comparative shortness of the spire. The upper whorls are six or seven in number, convex and separated by impressed sutures; the last is evenly rounded, somewhat more globose on the back, than in front. The aperture is very large, semilunar, anteriorly rounded, posteriorly angular; the inner lip very thick; the fissure scarcely traceable, being covered by the inner lip.

The recent *Amp. fluctuata*, Sow., is nearly allied to this species, but it is broader and has a shorter spire. *Amp. mastoidea*, Pict. and Camp. (Mat. Pal. Suisse, 3me. Ser., p. 381, pl. 76, figs. 2 and 3,) from the 'étage Urgonien' at Ste. Croix, is also a large, allied form.

Locality.—Ninnyoor, in whitish arenaceous limestone; not rare with *Ner. Blanfordiana, Turr. elicita, Cypræa;* and other species, which mostly resemble such forms as at present live in the neighbourhood of, or on, coral reefs.

Formation.—Arrialoor group.

LXVI. EUSPIRA, *Agassiz*, 1837.

1. Euspira pagoda, *Forbes*, sp., Pl. XXI, Figs. 7 and 8.

1846. *Natica pagoda*, Forbes, Trans. Geol. Soc., Lond., VII, p. 136, Pl. XII, Fig. 14.
1847. „ *affinis*, D'Orbigny, Paléont. Astrolabe, etc., Pl. IV, Fig. 3.

Eusp. testa ovato-conica, levigata, spira elevata, subturrita; anfractibus subplanatis, postice ad suturam anguste sed profunde canaliculatis, ultimo anfractu inflato, rotundato; apertura semilunari, labio tenui, antice ad marginem parum incrassato, columella distincte fissurata.

Spiral angle 60°- 75°; sutural angle 5°- 6°.
Height of aperture : total of shell (considered as 1·00) ... ... 0·49 - 0·56.

An elongated species with a turreted spire, composed of about 8-10, slightly convex volutions, the posterior edge of which is rounded, the suture being, however,

narrowly but deeply canaliculated. The surface is smooth, occasionally with some traces of a fine spiral punctuation or striation, as is common among all *Naticidæ*. The aperture is semilunar, slightly oblique, much narrower posteriorly than anteriorly; the inner lip thin and anteriorly furrowed, exposing a slight fissure.

The height of the spire, as compared with that of the aperture, the large number of volutions and the narrow but deep sutural canaliculation, easily distinguish this species from similar forms, like *Natica (Amauropsis?) Clementina*, D'Orb., *Littorina (Euspira) pungens*, Sow., and others. Geinitz (Quadersandst., etc., 1849-50, p. 128,) unites under the name *Nat. vulgaris*, Reuss, a very large number of apparently different species, some of which very much resemble our Indian fossil. We would also draw attention to *Auricula spirata* and *Nat. lamellosa*, Römer (Kreide. pl. 11, fig. 4, and pl. 12, fig. 13), two apparently identical species which, as regards the form and small height of the volutions, are remarkably like our *Eusp. pagoda*, but Römer's descriptions and figures, referring on the one hand to a doubtful thickening of the outer lip and on the other to strong lamellar, transverse striæ, do not at the present permit an identification. A similar doubt exists with regard to the identity of our species with *Nat. exaltata*, Goldf. (Petr. Ger. III, p. 119, pl. 199, fig. 13).

Locality.—Between Andoor and Veraghoor, in light coloured sandstone; not common.

Formation.—Arrialoor group. Prof. Forbes' specimens are also from the upper beds near Pondicherry.

2. Euspira Indrana, *Stoliczka*, Pl. XXII, Fig. 15.

Eusp. testa globose-conica, spira regulari, acuminata; anfractibus circiter septenis, planiusculis, suturis paulo impressis junctis, ultimo inflato, globoso; apertura ovata, labio tenui, columella excavata.

Spiral angle 72°; sutural angle 5°.
Height of aperture : total of shell (considered as 1·00) ... ... 0·62.

This species is distinguished by its regularly conical and pointed spire, being composed of numerous almost plain volutions, separated by a shallow suture. The last whorl is much inflated and globose, the surface being marked with oblique striæ of growth, although otherwise smooth, the aperture ovate with a thin inner lip, and the columella distinctly excavated. The species in form resembles *Littorina (Euspira) pungens*, Sow. (Trans. Geol. Soc., Lond., 1836, IV, p. 343, pl. 18, fig. 5), but this last one has the whorls near the sutures canaliculated, as can be observed on typical specimens from the Blackdown Greensand, though Sowerby's figure is not very clear on this point.

Locality.—East of Anapaudy; only the figured specimen has as yet been found.

Formation.—Trichinopoly group, but near the boundary of the Arrialoor group.

3. Euspira rotundata, *Sowerby*, sp., Pl. XXI, Fig. 9.

1825. *Turbo rotundatus*, Sow., Min. Conch. V, p. 45, Pl. CCCCXXXIII, Fig. 2.
1838. *Euspira rotundata*, Agass.; — *Natica id.* auctorum.

Eusp. testa ovato-globosa, spira moderate elevata; anfractibus levigatis, regulariter convexis, suturis simplicibus, impressis junctis, ultimo globoso; apertura semilunari, columella anguste excavata, labio tenui.

Spiral angle 85°; sutural angle 5°.
Height of aperture : total of shell (considered as 1·00) ... ... 0·58.

Shell ovate, with moderately elevated spire, composed of six or seven convex whorls, which are separated by simply impressed sutures; last volution very globose and evenly rounded at the periphery; aperture ovate, inner lip thin, columella at its termination distinctly but narrowly excavated. The strong globosity of the whorls well characterizes this species, which was first described by Sowerby from the Blackdown Greensand beds as a *Turbo*.

Locality.—Comarapolliam, in light colored sandstone; rare.

Formation.—Arrialoor group.

4. Euspira spissata, *Stoliczka*, Pl. XXII, Figs. 3 and 4.

Eusp. testa sub-globosa, spira brevi, acuminata; anfractibus planiusculis, postice ad suturas truncatis atque applanatis; ultimo valde inflato, ad medium latissimo, convexo; superficie striis incrementi minutis atque alteris spiralibus numerosis puncturatis notata; apertura dilatata, postice angustata, antice lata ac rotundata, labio tenui, columella ad terminationem furcata.

Spiral angle 98°; sutural angle 6°.
Height of aperture : total of shell (considered as 1·00) ... ... 0·68.

This species has somewhat the form of a small and depressed specimen of *Amp. bulbiformis*, but it is readily distinguished from it by the want of any strong callosity on the inner lip, and by a much finer and closer punctuation of its surface. The whorls are posteriorly flattened near the suture, and marked with 3-4 very fine spiral striæ. The last whorl is broadest about the middle and convex, the inner lip anteriorly, at the termination of the columella, somewhat flattened and distinctly grooved, but not fissured.

The species resembles Forbes' *Natica obliquestriata*, and from the author's description one would certainly suppose them to be the same, though this is not the case (*vide* postea).

Locality.—Kolakonuttom, in bluish sandstone; pretty common.

Formation.—Ootatoor – and Valudayur – groups.

5. Euspira lirata, Sowerby, Pl. XXII, Fig. 2.

1831. *Natica lyrata*, Sow., Trans. Geo. Soc., Lond., III, Pl. XXXVIII, Fig. 11.
1842. „ „ „ d'Orbigny, Pal. franç., terr. crét., II, p. 161, Pl. CLXXII, Fig. 5.
1865. „ „ „ Stoliczka, Sitz. Akad., Wien, LII, Revision etc., p. 45.

Eusp. testa rotundate-ovata, levigata, spira brevi, gradata, apice acuminata; anfractibus subplanis, prope suturam canaliculatis, ultimo inflato, ad medium

convexo, postice angustiore; apertura semilunari, labio tenui, columella profunde excavata.

Spiral angle 102°; sutural angle 4° - 5°.
Height of spire : total of shell (considered as 1·00) ... ... 0·75.

This well known European species is distinguished from *Eusp. spissata* by a distinct canaliculation of the whorls along the suture, by a largely umbilicated columella, and by a somewhat shorter spire, the large size of the last volution being similar in both. The general structure of the shell is also somewhat thinner, and less distinctly punctuated in the former than it is in the present species.

Locality.—Neighbourhood of Ninnyoor, in whitish arenaceous limestone; not rare.—In Europe the species occurs all through the Alps, as also in Germany in the upper cretaceous beds, which are equivalent to d'Orbigny's *Turonien* and *Sénonien.* The species was again only lately (Würtemberg. Jahreshefte XXIII, 1867, p. 243,) found in Palestine by Prof. Fraas in bituminous limestone with *Baculites anceps*, Lam., etc.

Formation.—Arrialoor group, being the most recent of our S. Indian cretaceous deposits.

6. Euspira Marlæ, d'Orbigny, Pl. XXII, Figs. 6-8.

1846. *Natica suturalis*, Sow. apud Forbes, Trans. Geo. Soc., Lond., VII, p. 137; non *id.* Gray, 1839.
„ „ *saturnalis* „ „ „ „ „ „ „ „ Pl. XV, Fig. 1; non *id.* Grat., 1843.
1847. „ *Mariæ*, D'Orbigny, Paléont. Astrolabe, Pl. III, Figs. 32-33.
1850. „ „ „ Prodrome, II, p. 221.
1851. „ *vulgaris*, Reuss apud Müller, Petræf. Aach. Kreidef., Pl. II, p. 14 (non *id.* Reuss).

Eusp. testa sub-globosa, levigata, spira brevi aut moderate elevata, anfractibus quinis seu senis, convexiusculis composita, ultimo maximo, latiore quam alto, omninis postice canaliculatis, margine suturali tumescente instructis; apertura semilunata, labio tenui; basi ultimi anfractus convexa, in medio profunde lateque excavata.

Spiral angle 90° - 110°; sutural angle 5°.
Height of aperture : total of shell ... ... (considered as 1·00) ... 0·68.
„ „ „ : width of the last whorl („ „ „) ... 0·72.

The short spire, globose form, great width of the last volution, and the posterior canaliculation, having along the suture a distinctly thickened margin, are the principal characters of this species. The surface is smooth, except that the usual lines of growth are traceable; the basis of the last whorl is roundish, and its columellar excavation increasing in width with the size of the shell; the aperture semilunar, large, but not very oblique, the inner lip thin.

Forbes' figure is very characteristic and does not leave any doubt as to the identity of the species; D'Orbigny's representation is, however, very insufficient; it shows the sutural margin only slightly, and no excavation on the columella; it would have been impossible without a comparison of the originals to identify both. I have quoted the *Nat. vulgaris* of Müller as a synonym, because I have been able to examine the original specimens in Prof. Müller's collection. It is very interesting to find this species in the Senonien deposits of Aachen, for this makes it probable

that it may also be found at other localities in Europe. I suspect that the figure 5 given by Guéranger in his Album Paléont. d. l. Sarthe, 1867, pl. 10, is a representation of our *Eusp. Mariæ*. Guéranger left the species undetermined.

Localities.—Garudamungalum, W. of Kullygoody, Alundanapooram, Anapaudy, Andoor, etc.; common, and apparently a very characteristic fossil of the

Formation.—Trichinopoly group.

LXVII. GYRODES, *Conrad*, 1860.

1. Gyrodes pansus, *Stoliczka*, Pl. XXII, Figs. 9–13.

Gyr. testa sub-globosa, spira paulo elevata, aut depressa; anfractibus omninis postice truncatis, applanatis seu canaliculatis, striis incrementi minutis seu plus minusve rugosis, arcuatis instructis, ultimo valde inflato; basi late profundeque excavata; margine umbilicali in junioribus speciminibus crenato, in adultis plus minusve acute-angulato; apertura amplissima, ovata, in junioribus antice angulatim sub-effusa.

Spiral angle 120°-160°.
Height of aperture : width of last whorl (considered as 1·00) ... ... 0·73.
The largest specimen in our collection measures 40 mm. in the height and 50 mm. in the width of the last whorl.

Shell globose, with a short or scarcely elevated spire; volutions six or seven, posteriorly broadly flattened or canaliculated, often with strongly raised and curved striæ of growth, and with some traces of a fine, spiral punctuation. The last whorl is much the largest, broader than high, and at the basis largely umbilicated. In young specimens the edge of the umbilicus is very distinctly crenulated, in older ones it is simply angular; in all stages of growth there is a slightly raised rib traceable near the extreme edge of the umbilicus. The aperture is very wide, anteriorly rounded, posteriorly acute; the inner lip has no trace of a columellar callosity, save the thin umbilical rib which terminates with a very slight swelling on the edge of the lip.

Conrad also mentions in the description of his *Gyr. crenata* (Journ. Ac. Nat. Sc. Phil., IV, p. 289,) an internal rib in, and a crenulated margin of, the umbilicus, but it is impossible from the author's short description to identify our fossil with the American one. Large specimens of our species are especially distinguished by the broad sutural flattening, and by the strong bending of the striæ of growth on the posterior edge, which separates the flat from the convex portion of the whorls, (*vide* Figs. 11 and 12a). Several of the forms, described by different authors under the name of *Nat. canaliculata*, are very similar to our Indian species.

Localities.—Neighbourhood of Odium and Moraviatoor (Oot. gp.); Serdamungalum, Alundanapooram, Anapaudy (Trich. gp.); Vylapaudy, Malvoy, and Comarapolliam, (Arr. gp.); common, except at the three last named localities, and generally in company with *Amp. bulbiformis*, though not so numerously represented as the latter.

Formations.—Ootatoor, – Trichinopoly – and Arrialoor – groups.

2. Gyrodes tenellus, *Stoliczka*, Pl. XXI, Fig. 14.

Gyr. testa semiglobosa, spira brevi; anfractibus paucis, postice truncatis, atque applanatis, ultimo maximo, latissimo; basi ad medium late excavata, ad marginem angulata, vix crenulata; apertura per-obliqua, antice rotundata, valde producta, postice angusta et acuminata, labio tenui.

Height of the shell : its width (considered as 1·00) ... ... 0·83.

This species is distinguished from the last by its more depressed form, by the want of crenulation both on the posterior flattening of the whorls and on the edge of the umbilicus, also by a considerably more oblique aperture, which is very narrow, posteriorly pointed, and anteriorly broadly rounded; the inner lip is thin, without a trace of a columellar callosity.

Localities.—E. of Anapaudy, (Trich. gp.); Malvoy, W. of Arrialoor, Mulloor, (Arr. gp.); not very common; none of the specimens found attain the size of the preceding species.

Formations.—Trichinopoly – and Arrialoor – groups.

XLVIII. MAMMILLA, *Schumacher*, 1817.

1. Mammilla edura, *Stoliczka*, Pl. XXIII, Fig. 1.

Mamm. testa semiglobosa, depressa, levigata, spira brevissima, apice acuminata; anfractibus 3—4, *suturis vix conspicuis junctis, ultimo per-lato, postice subconvexo, antice ad basin anguste rotundato, late umbilicato; labio calloso, crasso, brevi.*

Spiral angle nearly 130°.
Height of shell : its width (considered as 1·00) ... ... 0·74.

A much depressed semiglobose shell with a very short pointed spire; the last whorl embracing to a great extent all the previous ones, being much broader than high. The sutures are scarcely traceable, and there is no perceptible flattening of the posterior margin of the whorls to be observed. The species is principally to be distinguished by the very great callosity of the inner lip, though the shell itself has no considerable thickness; the umbilicus is very large at the base and funnel shaped, becoming rapidly narrower towards the interior centre of the shell; there is no trace of any contorted thickening of the columella in the umbilicus, in spite of the great thickness of the inner lip. The outer lip is sharp and posteriorly separated from the former by a narrow channel; the surface of the shell is perfectly smooth, and the aperture very oblique and anteriorly produced.

Locality.—Ninnyoor; only a few specimens have been found in whitish, arenaceous limestone, associated with *Cypræa*, *Nerineæ*, and *Hippurites*.

Formation.—Arrialoor group.

2. Mammilla carnatica, *Stoliczka*, Pl. XXII, Fig. 5.

Mamm. testa ovata, subglobosa, levigata, spira brevi, subacuta; anfractibus 4–5, paulo convexis, suturis simplicibus junctis, ultimo maximo, inflato, vix latiore quam alto; apertura semilunari, labio calloso, umbilico valde angustato.

Spiral angle about 110°.
Height of shell : its width (considered as 1·00) ... ... 1·20.
Height of last whorl : its width („ „ „) ... ... 0·09.

This small ovoid shell bears a remarkable resemblance to many of the recent species of *Mamma*, but the inner lip in our specimens is simply thickened, there being no perceptible trace of a funiculus in the very narrow umbilicus. The spire is rather obtuse, consisting of four or five slightly convex volutions, the last of which is very nearly as high as it is broad. The aperture is oval, pointed posteriorly and rounded anteriorly, but not produced. Its characteristic form readily distinguishes this species from the former, but it cannot be considered generically distinct. The nearest allied species are, as I have already said, living forms like the European *Mamma (Natica) nitida*, Donov., which was at first described as a *Nerita*, and others.

Locality.—Between Andoor and Veraghoor, in greyish sandstone; very rare.

Formation.—Arrialoor group.

XXXIX. *Family,—VANIKORIDÆ.*

Vanikoridæ, H. and A. Adams, Gen. I, p. 374; *Neritopsidæ* et *Vanicoridæ*, Gray, Guide, 1857, pp. 51 and 121; *Neritopsidæ*, Chenu, Man. I, p. 330.

Of the two genera referred by H. and A. Adams to this family only the animal of *Vanikoro** is at present known, and that chiefly from the researches of Quoy and Gaimard.

The animal of *Vanikoro cancellata* is small, with the head somewhat produced, posteriorly with large, membranaceous expansions on the sides of the foot; the tentacles are short, conical, with the eyes at their outer base; the rostrum is produced and wrinkled, but it is not known whether it is retractile or not; the jaws are stated to be horny and flat, the lingual membrane broad, short and provided with only two series of teeth. The operculum is horny, thin, ovate, subspiral, composed of very few, indistinct volutions.

The shell is ovate, globose, consisting of a few rapidly increasing whorls; the surface usually ornamented with spiral and transverse striæ or ribbings, rarely smooth; aperture roundish, large, with the outer lip entire, and the inner lip more or less thickened.

The following genera have to be placed in this family:—

1. *Vanikoro*, Quoy and Gaimard, 1832; (*Narica*, Recluz, 1841, D'Orbigny in Fauna des Antilles, tom. II, p. 39). *Shell moderately thick, globose; last whorl very large; surface of shell spirally striated, cancellated or transversely ribbed, sometimes*

* One of the Pacific Islands, where they observed the animal of *Vanik. cancellata* (*vide* Zoologie d'Astrolabe, Vol. II, p. 239.)

smooth inner lip moderately thickened, simply curved or slightly twisted, not toothed; columella excavated; the recent species are usually white. Though the authors of the Zoology of the 'Astrolabe' first pointed out the differences between the genera *Velutina* and *Vanikoro*, they were not quite certain whether a generic separation of the two was really necessary. In reality they only intended to propose the name *Vanikoro* for the peculiarly cancellated species of *Velutina*. The generic distinctions of these from true *Velutinæ*, however, have been already in 1830 confirmed by Deshayes, and the propriety of the former name as having generic value acknowledged. The same was done by Gray in 1840, and reference was made to the anatomy of the animal as illustrated by Quoy and Gaimard. It is therefore quite clear, that the name *Vanikoro* has priority before *Narica*, which was, on the authority of Recluz, introduced by D'Orbigny only in 1841.

H. and A. Adams quote twenty-six recent species of *Vanikoro*, which number was lately increased by the researches of Carpenter, A. Adams, Deshayes and others to about thirty-two. The genus appears to be also numerously represented in former geological periods. Comparatively only few tertiary species are known; the cretaceous forms seem to be, however, more numerous. Pictet and Campiche (Mat. p. l. Pal. Suisse, 3me. Ser., p. 400,) mention four species, from which the *Nat. carinata*, Sow., may be excluded, because the form and the great thickness of its shell makes it more probable that the species is a *Fossar* (fam. *Littorinidæ*, vide p. 261). To the three other remaining species may be added *Nat. crenata*, Zek., from the Gosau-deposits (Sitz. Akad., Wien, 1865, LII, Stoliczka, Revision. etc., p. 47), *Naticella Strombeckii*, Müller (Aach. Kreidef., II, p. 16, pl. 3, fig. 20), very likely also *Nat. Klipsteini*, Müll. (*ibid.*, p. 14, pl. 5, fig. 1), and perhaps many others. In fact of all the species, quoted by Pictet and Campiche (loc. cit., pp. 408-409,) under the name of *Neritopsis*, the larger number probably belongs to *Vanikoro*, as I shall mention subsequently. Meek has in his Check list of cretaceous and jurassic fossils, p. 18 (Smithson. Misc. Coll. n. 177,) a *Vanikoro ambigua*, Meek and Hayden (*Natica id.* olim) from N. America.

It is not improbable, that the greater portion of the jurassic and triassic species of *Neritopsis* also belong to *Vanikoro*, as certainly do nearly all the species described by Münster and Klipstein from St. Cassian under the name of *Naticella*. In the South-Indian cretaceous deposits only one species has yet been found, the *V. munita*, Forbes, sp.

2. *Naticodon*, Ryckholt, 1847 ? (Mélanges pal., 1852, part I, p. 75,) has the general globose form of *Vanikoro*, *but the inner lip is usually thickened and always provided with some kind of a tooth; the columella is either slightly hollowed out or solid; the surface smooth or ornamented with various spiral or transverse striæ.*

This genus has been proposed for a number of palæozoic species and, although not accepted by the larger number of conchologists, it appears to be a good genus, which ought to be classed in the family *Vanikoridæ*, forming a connecting link between *Vanikoro* and *Neritopsis*, the former of which has the columellar lip smooth, the latter is insinuated in the middle, or provided with two strong teeth,

while *Naticodon* has only one; as regard the thickness of the shell this transition seems equally to hold good. It is possible, that some of the smooth liassic and jurassic species of *Neritopsis*, like *N. lævis*, Stol. (Sitz. Akad., Wien, 1861, XLIII, p. 179, pl. 3, fig. 6,) and others belong to *Naticodon*. With regard to cretaceous species it is very difficult to make any suggestions. I have never myself observed a single species with only one columellar tooth, though I am rather disposed to believe, that species like *Neritopsis Renauxiana*, D'Orb. (Pal. franç. crét. II, p. 175, pl. 176, figs. 5-6), and perhaps *Nerit. ornata*, D'Orb. (ibid. figs. 8-10,) and others may be rather called *Naticodon* than *Neritopsis*.

3. *Neritopsis*, Grateloup, 1832 (*Sowerby*, 1834). *Shell thick, globose, whorls rapidly increasing in width; last volution very large, more or less enveloping the previous ones; inner lip strong, callous, distinctly excavated in the middle; columella generally solid; surface of shell usually cancellated or spirally ribbed.*

The great consistency of the shell, and the thickened and excavated inner lip, readily distinguish this genus from the two last named ones. There are only one or two* recent species known, and the fossil ones also do not appear to be very numerous, though they are undoubtedly more common in the older periods than in the more recent ones, having had their maximum in the time between the upper triassic and the middle jurassic periods. Pictet and Campiche (Mat. Pal. Suisse, 3me. Ser., pp. 408-409,) quote from cretaceous rocks fifteen European species, but of all those that are figured or properly diagnosed, I find that only the *N. Robineausiana* and *N. pulchella* appear to be true *Neritopsis;* possibly also the *N. lævigata*, though this is by no means equally certain. All the remaining species described under the generic name *Neritopsis* are doubtful, though some of them may probably represent imperfect specimens of *Neritopsis*; others, however, more likely belong to *Vanikoro*, and again some of them, like *N. scalaris*, Seeley, or *N. costulata*, Römer, may possibly be shown to be species of *Nerita*.

From North America, two species have been reported, *Nerit. ? Tuomeyana*, Meek and Hayden (*Nat. id.*, Proc. Acad. Nat. Sc. Phil., 1856, p. 270; Smithson. Misc. Coll. No. 177, 1864, p. 18), and *Nerit. biangulatus*, Shumard, Trans. Acad. St. Louis, 1860, p. 598.

We have procured from Sth. India only a single fragmentary specimen, which we shall describe as *Neritopsis crassa*.

LXIX. VANIKORO, *Quoy and Gaimard*, 1832.

1. Vanikoro munita, *Forbes, sp.*, Pl. XXII, Fig. 16.

1846. *Nerita munita*, Forbes, Trans. Geol. Soc., Lond., VII, p. 122, Pl. XII, Fig. 15.
„ *? Natica obliquistriata*, Forbes, *ibid.* „ „ „ p. 136, Pl. XII, Fig. 12.
1850. *Natica munita*, D'Orbigny, Prodr. I, p. 222.

Var. testa sub-globosa, sub-depressa, spira paulo elevata; ultimo anfractu multum latiore quam alto, ad basin rotundato, late excavato; apertura semilunari,

* I think a new species has been described from the Pacific Islands or Taheiti, but I am just now unable to find the reference.

postice paulo emarginata; superficie striis spiralibus atque transversalibus decussantibus notata.

Spiral angle 118°; sutural angle 3°.
Height of the last whorl : width of the shell (considered as 1·00) ... 0·66.

This is easily distinguishable from other known species of the same genus, by its very fine spiral and transverse striation and the great width of the last volution, as compared with its height. All the whorls are strongly convex and posteriorly along the suture somewhat flattened or even sub-canaliculated. The striæ of growth are strongly bent forward a short distance from the suture, and some of them are occasionally coarser than others. The basis of the last volution is convex, leaving a wide umbilicus open in the centre. The shell is thin, and neither of the margins of the roundish aperture are thickened or callous. The species was at first described by Prof. Forbes as *Nerita munita*. The identification of *Nat. obliquistriata* is somewhat doubtful, though I cannot refer it to any other species.

Locality.—N. of Odium, in dark bluish, calcareous sandstone; apparently rare. Forbes' specimens are from a similar sandstone.

Formation.—Ootatoor group.

LXX. NERITOPSIS, *Grateloup*, 1832.

1. Neritopsis crassa, *Stoliczka*, Pl. XXIII, Fig. 7.

Nerit. testa semiglobosa, crassa; anfractibus tribus, postice planiusculis, ultimo valde inflato atque semi-globoso; apertura rotundata, postice paulo angustata, marginibus interne incrassatis; labio in excavatione prope marginem anteriorem obsolete unidentato; superficie costulis spiralibus atque transversalibus decussantibus, spinulosis ornata.

Height of shell : width of last whorl (considered as 1·00) ... ... 0·70.

Though our specimen is in some respects deficient, it has the aperture perfectly preserved, and thus admits of a certain generic determination. The shell itself had a semiglobose shape, the whorls are posteriorly somewhat flattened, and the surface is ornamented with spiral and transverse ribbings, which produce small, spinose tubercles on the places where they cross each other. The internal space of the aperture is round and posteriorly contracted. In the excavation of the inner lip there is a small tooth placed nearer to the anterior than to the posterior edge. The margins of the aperture are internally strongly thickened, but the extreme edge of the outer lip itself is sharp and slightly undulating. With reference to the ornamentation, our species bears a strong resemblance to *Neritop. Robineausiana*, d'Orb. (Pal. franç. crét., II, pl. 176, figs. 1-4), but is easily distinguished from it by the other characters.

Locality.—Neighbourhood of Odium, in soft, rather quartzose sandstone.

Formation.—Ootatoor group.

XL. *Family,—VELUTINIDÆ.*

H. and A. Adams, Genera, I, p. 199.

The animal of *Velutina* has a large, oblong foot, the operculigerous lobes and the edge of the mantle somewhat expanded and partially reflexed on the shell, the head broad, tentacles subulate, short, far apart, with the eyes on short bulgings at their outer base; proboscis elongate, cylindrical, annulated; lingual membrane short with seven series of teeth, the central being large, broad, hooked in the middle and serrated at the sides, the next pair is similarly formed, but externally more serrated than internally, the two outer pair simple; the gills are said to consist of two plumes, composed of numerous striæ, one of them being considerably smaller; no operculum is known.

The shells are distinguished by *the small number of whorls, the last of which is very large with a roundish and entire aperture, they are usually thin, having the surface either smooth or spirally striated.*

The species of *Velutina* are often found attached to stones at low water, but they are also met with at considerable distances from the shore, occasionally at great depths. The thin structure of the shell gives them indeed a pelagic rather than littoral character.

Gray (Guide, 1857, p. 45,) and Chenu (Man. I, p. 212,) class in the *Velutinidæ Lamellaria*, *Marsenina* and others, which are, however, separated by H. and A. Adams as a distinct family, *Lamellariidæ* (Gen. I, p. 200). I am not acquainted with the animals of any of the *Lamellariidæ*, but it appears from the form of their shells, that they cannot well be separated. The principal differences in the animals only consist in the greater development of the mantle and of the operculigerous lobes covering in the *Lamellariidæ* nearly the entire shell. In consequence of this expansion and covering of the mantle, the shell remains very thin and pellucid, as in *Vitrina*. There appears to be also a slight difference in the teeth, but all these distinctions do not seem to be so essential, as to necessitate the formation of a separate family, perhaps scarcely that of a sub-family, *lamellariinæ*. In a fossil state such thin shells are only exceptionally found preserved; they are, therefore, less important in fossil conchology.

I may at this opportunity mention a number of genera which, as regards the form of their shells, closely resemble many *Velutinidæ*, and would seem to connect this family with the *Capulidæ*. But their animals exhibiting several very remarkable distinctions from both of the last mentioned families, they have therefore been placed in the neighbourhood of the *Auriculidæ* and *Limnæidæ*. The genera, to which I mean to draw attention, are those like *Otina*, Gray (H. and A. Adams, Gen. II, p. 249), *Camptonyx*, Benson, (ibid, p. 644), *Lithotis*, Blanford (Ann. Mag. Nat. Hist., 1863, Vol. XII, p. 186), and others which have the gills rudimentary or not developed at all, and which are chiefly found living in the moist atmosphere on rocks along the sea coast. It appears to me, that these genera stand in precisely the same relation to the *Capulidæ* and *Velutinidæ* as

do, for instance, *Assiminea*, *Truncatella*, *Tomichia*, and others to the *Rissoidæ*, that is, they seem to be forms which are undergoing a change from Branchifera into Pulmonifera.

My present remarks will be restricted only to a few genera of the true *Velutinidæ*.

1. *Naticina*, Gray, 1842 (H. and A. Adams, Gen. I, p. 211). *Shell ovate, with moderately elevated spire, thin, last whorl ventricose, surface spirally striated; aperture large, outer lip sharpened, inner lip a little thickened, occasionally leaving a slight fissure exposed at the termination of the columella.*

H. and A. Adams class this genus next to *Sigaretus (Catinus)* in the *Naticidæ*, but A. Adams states subsequently (Ann. Mag. Nat. Hist., 1860, VI, p. 109) that it ought to be placed in the *Velutinidæ*. The only cretaceous species, which has as yet been described, is *Naticina obliqua*, Gabb (Pal. Calif., 1864, I, p. 109, pl. 21, fig. 112), from the Californian deposits; this species has rather a wide aperture more resembling a *Sigaretus*. I shall describe from our South-Indian rocks another species which, although based upon a rather imperfect specimen, the shell being only partially preserved, is from its general appearance most probably another cretaceous representative of this genus.

2. *Lysis*, Gabb, 1864 (Pal. Calif., I, p. 138). "General form like *Stomatia (=Sigaretus)*. *Shell sub-spiral, very oblique; spire moderately prominent; whorls spirally costulated. Aperture narrow, oblique; outer lip simple; columellar lip straight and rather heavily incrusted. Umbilicus broad, but entirely closed by a concave expansion of the incrusting layer of the inner lip.*"

Gabb describes one species, *L. duplicosta*, from the cretaceous rocks of California; it appears to be rather a thin shell, principally differing from *Naticina* by the great thickness of the inner lip which covers the umbilical region.

3. *Amplostoma*, Stoliczka, 1868.

Ampl. testa sub-ovata, tenui, spira brevi; anfractibus paucis, ultimo maximo, ventricoso, antice valde producto, ad basin late-excavato; apertura elongate-ovata, antice atque postice sub-angulata, labio tenui, labro ad marginem dilatato, expanso atque reflexo; superficie sub-levigata.

This genus is based upon a remarkable species from our cretaceous deposits; it very much resembles in form a *Succinea*, but is widely umbilicated, and has the outer lip expanded and reflexed. From *Velutina* it differs both by the large umbilicus and by the expanded outer lip. Both this and the last named genus very much remind one of some forms of *Coralliophila (rapaninæ)*, in which the anterior canal is sometimes very indistinct.

We only know as yet the cretaceous *Amp. auriforme*, which will be noticed subsequently. There is, however, a *Littorina macrostoma* described by Sandberger from the *Stringocephalus*-limestone of Villmar (Rhein. Schichtensystem, etc., p. 221, pl. 25, fig. 16), which in all its principal characters agrees with our *Amplostoma* and most likely belongs to this genus. Deshayes describes from the Paris basin under the name of *Sigaretus problematicus* a minute shell, which in general form

likewise very much resembles *Amplostoma*, but it has the outer lip not expanded, (Anim. s. vert. foss. bas. Paris, 2me. edit., Vol. III, p. 90, pl. 62, figs. 7-9).

4. *Velutina*, Fleming, 1820 (H. and A. Adams, Gen. I, p. 199).

The recent species are readily distinguished by their globose form and their thin shells; they are usually covered with a thickened epidermis. Up to this time fossil species have been with a few exceptions only described from tertiary beds. Of known cretaceous shells I can perhaps mention *Natica Sueurii*, Pictet and Renev., (Pal. Suisse, Descript. Foss. terr. aptien, etc., livr. 1, 1854, p. 37, pl. 3, fig. 9) which may belong to *Velutina*. I describe another species from South India, *Vel. orientalis*, very much resembling in form some of the recent species.

When lately examining in Maestricht the collection of Dr. J. Bosquét, this zealous naturalist showed me a very fine specimen of a new species of *Velutina* from the cretaceous deposits of Vaelsbrock near Aachen. The shell consists of only two, or two and a half whorls, the spire being very short, scarcely elevated, but the last whorl is very large and somewhat depressed on the back.

Under *Natica* and other allied genera, a considerable number of fossil species are described which will probably have to be transferred to the *Velutinidæ*. I will mention, for instance, the numerous triassic species of globose *Natica* which do not differ at all from *Velutina*, except perhaps by a somewhat more thickened shell; certainly these forms cannot remain under the generic name of *Natica*;—vide Klipstein's Oestl. Alpen, pl. 13; Stoppani's, Pal. Lomb. Ser. I, pl. 10; *Nat. complanata*, Stopp., *Nat. lemniscata*, Hörn.; ibidem, pl. 11, *Nat. nautiliformis*, Stopp., etc. Thus it is very probable that the number of fossil *Velutinidæ* will soon very much exceed that known at present.

5. *Platyostoma*, Con. (Hall. Pal. New York, II, p. 286).

The characteristics given by Conrad do not differ from those of *Velutina*; but several of the species have the striæ of growth insinuated in a way similar to that in some species of *Platyschisma*,

6. *Strophostylus*, Hall, 1858 (Pal. New York, Vol. III, p. 303), has also the general form of *Velutina*, but the columella is said to be *twisted or spirally grooved within, (not reflected)*, while the columellar lip of *Platyostoma* is simply thickened. The typical form of *Strophostylus* is much like that of *Sigaretus* (*Naticidæ*), but the shells are not spirally striated. Among the species described by Hall some very much resemble in form *Platyceras*, which is intermediate between the two families *Velutinidæ* and *Capulidæ*; thus showing the importance of both of these for the study of fossil Conchology. Until, however, careful monographical researches have been extended to all these groups of shells, it will be really very difficult to arrive at any certain conclusions, as to the value of the different generic names.

The reason that the *Velutinidæ*, as also the *Janthinidæ*, at present number so few fossil species is because their thin shells are not easily preserved, and where they are, their form is often found so much distorted that a perfectly reliable determination almost becomes impossible. We give in the following pages

descriptions of three new species, *Naticina ornata*, *Amplostoma auriforme*, and *Velutina orientalis*, all from the highest beds of the South Indian cretaceous rocks, the Arrialoor group.

LXXI. NATICINA, *Gray*, 1842.

1. Naticina ornata, *Stoliczka*, Pl. XXIII, Fig. 6.

Nat. testa ovato-globosa, spira paulo elevata; anfractibus tribus, convexis, postice sub-applanatis; superficie costulis spiralibus, alternatim fortioribus et tenuioribus, atque striis incrementi minutis ornata.

A small sub-globose shell consisting of three convex, rapidly increasing volutions which are posteriorly somewhat flattened, over the entire surface ornamented with coarse and thin spiral ribs, and very numerous fine striæ of growth. In our specimen the surface is only on the last whorl partially preserved; having posteriorly near the suture six thinner spiral ribbings and on the lower and more convex portion seven stronger ones, which alternate with one to three finer striæ, also unequal in strength, the striæ of growth producing a fine crenulation on the former. This ornamentation is a little different from that usually found in *Naticina*, and more resembles that of the species described by Gabb as *Lysis*. The form of the aperture of our Indian species agrees, however, better with that of other *Naticinæ*, the aperture being wide, not much elongated, and having apparently the inner lip not remarkably thickened.

Locality.—S. E. of Arrialoor, in light coloured sandstone; very rare.

Formation.—Arrialoor group.

LXXII. VELUTINA, *Fleming*, 1820.

1. Velutina orientalis, *Stoliczka*, Pl. XXIII, Fig. 4.

Velut. testa sub-globosa, levigata, tenui, spira parum elevata; anfractibus tribus, convexis, suturis impressis junctis, postice paulo applanatis, ultimo valde inflato, convexo, latiore quam alto; apertura subrotundata, labio tenui, moderate curvato, labro arcuate expanso.

This species has very much the form of the recent *Velut. capuloidea*, having the spire slightly elevated, the whorls separated by deep sutures and the aperture enlarged and roundish. The inner lip is thin, and there is no distinct umbilical opening. The surface of the shell exhibits very fine striæ of growth, but is otherwise smooth.

Locality.—Near Comarapolliam, in whitish sandstone; very rare.

Formation.—Arrialoor group.

LXXIII. AMPLOSTOMA, *Stoliczka*, 1868.

1. Amplostoma auriforme, *Stoliczka*, Pl. XXIII, Fig. 5.

Ampl. testa subovata, sub-depressa, tenui, spira brevissima, duobus anfractibus, suturis profundis junctis, composita, ultimo antice valde producto, obliquo, late umbilicato, margine umbilici sub-acuto; apertura ovata, obliqua, angusta, antice atque postice subacuta, ad marginem interiorem dissoluta, labro expanso reflexo; superficie striis incrementi subrugosis obsolete notata.

This remarkable species very much resembles *Succinea* in form, having the last whorl rapidly enlarged in size, oblique and anteriorly much produced. The shell is thin and the surface almost smooth, leaving only indistinct and somewhat rugous striæ of growth traceable. The aperture is rather narrow, oval, anteriorly and posteriorly subangular; the outer lip expanded and with the margin reflexed; the inner lip thin, flattened, and posteriorly detached from the previous whorl; umbilicus large, with a sharpened edge round the basal periphery of the last volution.

I have already stated that this species is classed in the *Velutinidæ* principally on account of its thin shell, for in other respects it very much recalls the form of a *Coralliophila*.

Locality.—Comarapolliam, in light coloured sandstone; very rare.

Formation.—Arrialoor group.

XLI. *Family,—JANTHINIDÆ.*

H. and A. Adams, Gen. II, p. 85; Gray, Guide, 1857, p. 51.

This family is classed by the authors of the 'Genera' in the Heteropoda, but we believe that its proper place is in the neighbourhood of the *Velutinidæ*. The shells are so very thin and fragile that it must be considered an exception to the general rule, if any species belonging to this family are met with in a fossil state, though shells of *Janthina* and *Recluzia* are at present not at all uncommonly thrown up on the sea-shore.

I do not know any cretaceous species which belong to the family. I may, however, take the opportunity of drawing attention to a few interesting palæozoic forms which may belong to it; as, for instance, *Scalites*, Conrad, *Raphistoma*, Hall, and others. It is not correct to place *Raphistoma* in the *Pleurotomariidæ*, because Hall distinctly says that the striæ of growth are continuous and simply curved (like in *Janthina*), but not interrupted so as to form a separate band, as is invariably the case in all the genera of the *Pleurotomariidæ*.

XLII. *Family,—CALYPTRIDÆ.*

H. and A. Adams, Gen. I, p. 363; *Calyptræadæ*, Gray, Guide, 1857, p. 115; Chenu, Manuel, p. 323.

Gray proposed a separate division under the name of Placomobranchia including this and the next family, and added to these the *Vanikoridæ* (= *Neritopsidæ*) which appear to be, however, better placed next to the *Naticidæ*. Deshayes

adopts in his last edition of the Paris fossils (Vol. II, p. 259) the above named division of Gray as a sub-order, though this does not appear to have the same rank as the other corresponding divisions. Gray further distinguishes in the *Calyptridæ* three sub-families, *crepidulina*, *galerina*, and *calyptræina*. It is likewise not probable that these sub-divisions will prove of much practical use, though the first and third one perhaps may occasionally be found convenient. The shells of the *Calyptridæ are Patelli-form or conically elevated, subspiral, with a sublateral or posterior apex, internally with simple or variously folded processes, usually originating at the apex; rarely is there a partial basal disc formed resembling that of the Onustidæ. The aperture is in consequence of this varied form of the shell very different in shape, but always very large; none of the species are known to have an operculum.*

The principal genera, as usually accepted, are—

1. *Galerus*, Humphrey, 1797. It will always be very difficult to distinguish fossil species of *Galerus* and *Infundibulum*, for the depressed conical form cannot be considered as the principal character of *Galerus*, though the more rapid increase of the whorls may often serve as a distinction between the two.

1*a*. *Galeropsis*, Conrad (Check list. eoc. fossils of N. America), proposed for *Galerus excentricus*, Gabb, which differs from other species of that genus by a more elevated spire.

2. *Infundibulum*, Montfort, 1810; (*Trochita*, Schum., 1817). Montfort's figure (Conch. syst., p. 166,) of his *In. typus* is certainly not very clear, but his description and reference to the relations of *Calyptra* help to recognize the character of the genus. He draws special attention to the thin structure of the internal layer which is exactly similar in *Calyptra*, and only in form resembles *Trochus*. It would simply be impossible to say that of *Carinidea concava*, Mart., which H. and A. Adams (Gen. I, p. 415,) refer under the name of *Infundibulum*, Montf, to *Polydonta*, as a sub-genus. This is hardly correct as far as *Carinidea* of Swainson is concerned (Treat. shells, 1840, p. 350), but we certainly cannot accept it with reference to Montfort's *Infundibulum*, however much he may have confounded other species of shells with it. There is indeed no good reason to be given in support of Schumacher's name *Trochita* as adopted by Adams, Chenu, Gray and others, because the name *Infundibulum* was accepted and well illustrated by other typical species before Schumacher's name was introduced *(vide* Sowerby's Min. Conch., 1815, Vol. I, pl. 97).

3. *Calyptra*, Klein, 1753, Ostrac., p. 118 *(Calyptræa*, Lamarck, 1799), Klein (loc. cit.) says: '*Calyptræ* nomen imponimus monoconchis rotundatis, natabili processu conico, obliquo ad figuram pileorum, etc.,—accedentes'; and in quoting the species he describes the first, *C. Rumphiana alba*, 'intra ossicula rotunda tubuli instar instructa, etc.' There is no necessity for changing the name into *Calyptræa*, to make it suited to generic denomination.

4. *Crucibulum*, Schumacher, 1817.

5. *Crepidula*, Lamarck, 1799. *Crypta*, Humphrey, 1797 [*teste* Swainson] cannot contest priority with Lamarck's name.

5*a*. *Spirocrypta*, Gabb, 1864, a sub-genus proposed for a cretaceous species from California (*vide* infra n. 12).

6. *Galericulus*, Seeley, 1861, proposed for a cretaceous species [*vide* infra n. 8].

Gray separates *Crep. solida*, Hinds, *C. rostriformis*, Gould, and others under the name of *Garnotia*, and several other names, as *Ergæa*, Adams, *Crepipatella*, Less., *Calypeopsis*, Less., etc., are quoted as sub-genera by H. and A. Adams, Chenu and other conchologists.

The *Calyptridæ* are largely represented among living shells; they are chiefly inhabitants of the warmer eastern and American waters, although several of them are also found in temperate zones, as in the Mediterranean sea. Some 120 species are known recent, and about the same number and an additional half have been described from tertiary deposits. In the older formations they are less numerous, their thin shells not being so well adapted to remain in good preservation as species of the *Trochidæ*. Of cretaceous species the following are reported :—

1. *Galerus excentricus*, Gabb (Pal. Calif., 1864, I, p. 136, pl. 20, fig. 95, and pl. 29, fig. 232; *Galeropsis id.*, Conrad, Smithson. Misc. Coll., 200, p. 11). Conrad refers this species like many others to the lower eocene, but my friend Gabb informs me that he is certain of the cretaceous age of those rocks.

2-6. *Infundibulum urgonense*, P. and Camp., *I. cretaceum*, D'Orbigny, *I. ciplyanum et tornacense* Ryckholt, and *I. supra-cretaceum*, D'Orb., *vide* Pictet Mat. p. l. Pal. Suisse, Foss. Ste. Croix, 3me. Ser., p. 693.

7. *Calyptræa sanctæ-crucis*, Pictet and Campiche, loc. cit., p. 696, pl. 97, fig. 38.

8. *Galericulus altus*, n. gen. and sp., Seeley, Ann. Mag. Nat. Hist. Ser. 3, Vol. VII, p. 292, pl. 2, fig. 19. This species is distinguished by two separate septa, the larger one originating below the incurved apex, and the smaller one at the base. Only the cast is as yet known; the upper surface of the shell, which has the form of a *Helcion*, not having been observed.

9. *Crepidula Gaultina*, Buvignier (Pict. et Camp. Mat. p. l. Pal. Suisse, Foss. Ste. Croix, 3me. Ser., p. 693, pl. 97, figs. 3-4).

10. *Crepidula Cooksoniæ*, Seeley (Ann. Mag., loc. cit., p. 291, pl. 11, fig. 18,) from the Cambridge Greensand.

11. *Calyptræa Grayana*, Tate, 1865 (Quart. Jour. Geol. Soc., Lond., XXI, p. 38, pl. 3, fig. 8,) from the cretaceous deposits of Ireland. The internal structure of the shell has not been observed by the author; its general form very much resembles that of *Tectura* and *Helcion*.

12. *Crepidula* (Subg. *Spirocrypta) pileum*, Gabb, (Pal. Calif., 1864, I, p. 137, pl. 29, fig. 233). This newly proposed sub-genus ought to differ from *Crepidula* (and *Crepipatella ?)* by a more distinctly spiral apex and by an oblique position of the internal plate, characters which it is very difficult to admit as generic distinctions in the fam. *Calyptridæ*. Conrad (Check list Misc. Coll. Smithson. Inst., No. 200, p. 11,) refers this species to the lower eocene beds which are considered by Gabb and other American geologists as being of cretaceous age; he besides quotes two other species,

13-14 (?). *Crypta prærupta* and *rostralis* which, if actually from the same beds as the last named one, have to be added to the list of cretaceous fossils.

15. *Calypt. semiglobosa*, Eichwald (Leth. Ross., XI, livr., 1867, p. 807), from the cretaceous beds near Osinoroo in Russia, is an *Infundibulum*.

The *Calyptræa cretacea*, Müller (Petr. Aachener Kreide., 1851, II, p. 51, pl. 6, fig. 12,) is justly considered by Pictet as a doubtful species and rather belonging to *Chama* or *Gryphæa* (not *Neritopsis*, for the inner lip would be concave about the centre, not convex). I was not able to find this species

in Prof. Müller's collection, but I must say that, so far as descriptions and general determinations are concerned, I found most of Prof. Müller's references correct, while many of his figures are decidedly bad and often contradict his own statements, not because the specimens were imperfect, but because they have been badly drawn.

With reference to the representation of the family *Calyptridæ* in our South Indian cretaceous deposits we are furnished only with very meagre materials.

Prof. Forbes described two species under the names of *Calyptræa ? elevata* and *C. ? corrugata*, both of which appear with far greater probability to belong to the family *Tecturidæ*. We shall state our reasons for this transfer subsequently, *vide* pp. 322 and 323.

The only trace which we have been able to discover, as indicating the occurrence of a species in our cretaceous rocks, is an impression (see Pl. XIX, Fig. 25) of the concave basis of a shell, together with a small portion of one side of a whorl. This impression appears to belong to an *Infundibulum*, and was found in the yellowish calcareous sandstones to the North of Moraviatoor in the Ootatoor group.

XLIII. *Family,—CAPULIDÆ.*

H. and A. Adams, Genera I, p. 370; Gray, Guide, 1857, p. 119; Chenu, Manuel, p. 328.

The shell of the Capulidæ is cup-shaped, with an eccentrical, subspiral apex and an enlarged aperture with entire margins. The muscular impression is usually horse-shoe shaped. No species are known to possess an operculum.

The genera quoted by H. and A. Adams are —

1. *Capulus*, Montfort, 1810, (Conch. Syst., p. 54), (*Pileopsis*, Lamck., 1812); Klein (Ostrac., 1753, pp. 118-119,) was the first to name these shells *Cochlearia* (non *id.*, Linn., and others) and '*Mitra hungarica.*'

2. *Amathina*, Gray, 1842, with the species *A. tricarinata*, Chem., and *A. bicarinata*, Pease. A third one was described by A. Adams as *Amath. nobilis* from the Japan sea (Proc. Zool. Soc., 1867, p. 312).

3. *Cochlolepas*, Klein, 1753 (Ostrac., p. 119; *Hipponyx*, Defrance, 1819). Klein's figure evidently represents the same shell which has been afterwards named *Hipponyx* by Defrance.

Amalthea, Schumacher, 1817, is distinguished by Adams as a separate genus, including certain species which simply excavate with their foot a superficial cavity on the surface of the stone or shell to which they are attached, and do not form a shelly plate distinct from the substratum. Mr. Fisher in a paper on the anatomy of *Hipponyx*, (*Cochlolepas antiquatus*, Jour. de Conch., 1862, X, pp. 4-17, pl. 2,) states, however, that the formation of a calcareous substratum is not a character of either generic or specific value.

Brocchia, Bronn, seems to be likewise a doubtful genus. It is distinguished from *Capulus* by certain undulations and crenulations of the posterior margin; but it has not as yet been proved whether this form of the shell is a normal one. The

shell is very variable in all species of *Capulidæ*, which during lifetime are more or less continually attached to foreign objects, and often alter its shape, or at least that of the peristoma, according to different forms of these. If a distinction can be traced in the form of the muscular impression, there would be more reason to retain the genus.

Chenu (Manuel, I, p. 329,) also quotes, in addition to the above genera, the remarkable miocene shell which has been named by Rang *Spiricella*, and which is apparently more correctly placed by other conchologists in the family *Umbrellidæ* of the Opisthobranchia.

In a geological point of view there are few other families of Gastropoda of equal importance with the *Capulidæ*. For while the *Calyptridæ* are scarcely known* with sufficient accuracy from beds lower than the cretaceous, the *Capulidæ* are largely represented already in the lowest silurian rocks, and upwards through all the secondary and tertiary deposits. Many of the palæozoic species exhibit certain peculiarities and have consequently been distinguished by separate names. One of these is *Acroculia*, Phillips, which differs very slightly from *Capulus*. Hall also introduced for another group of silurian *Capulidæ* the name *Platyceras*, Conrad, (Nat. Hist. of New York, Palæont. III, p. 309). Several of the forms of *Platyceras* are scarcely to be distinguished from others which have been described under the name of *Strophostylus*, Hall. The typical forms of this last genus appear to belong to the *Velutinidæ*. It is also possible that some of the palæozoic species usually called *Euomphalus* or *Straparolus* will be shown to belong to the *Capulidæ*.

The oldest forms of the *Capulidæ* from the lower silurian rocks have a thin shell, in form very much resembling *Umbrella* and *Tylodina*. When lately at Prague, I had an opportunity of examining several of these oldest known and really very simply formed Gastropoda, as pointed out to me by Mons. Barrande, the illustrious author of the "Systeme Silurienne de la Bohême." From triassic and liassic beds comparatively only a few species are known.

Of cretaceous species, Pictet (Pal. Suisse, Foss. Ste. Croix, p. 691,) enumerates ten, from which number he thinks the *Cap. arquatus*, Münst., (in Goldf. pl. 168, fig. 13,) ought to be excluded. It does not, however, seem to be of any advantage to refer this species to another genus, until the originals have been examined. In the new edition of Goldfuss' Petræf. Germaniæ it is retained as *Pileopsis arquata*, (*vide* Giebel's Repert. to Goldfuss' Petr. Germ., 1866, p. 90). Of the ten cretaceous species *Cap. elongatus*, Münst, sp. (= *C. lituus*, Ryckholt), the doubtful *C. arquatus*, Münst., sp., *Cap. militaris* and *carinifer*, Müller, seem to belong to the genus *Capulus*; *Cap. rhynchoides*, Ryckholt; *Cap.* [*Hipponyx*] *Dunkerianus*, Bosquet (of which there is a very good figure in Binkhorst's Monog. Gast. et Ceph. Craie de Limb., 1861, p. 58, pl. 4, fig. 12, and pl. 5, fig. 7), *Cap. ornatissimus* and *consobrinus*, D'Orbigny, *Cap. flexicostatus*, Ryckh., are probably species of *Cochlolepas*.

C. Troscheli, Müller, is a very peculiar form, having on each side a ridge running from the apex to the periphery which is at that place slightly insinuated. These characters differ from those of any known species of *Cochlolepas*, to which it can only provisionally be referred until more and better preserved specimens have been examined. The species in some respects recalls the genus *Metoptoma*, Phill., of the *Gadinidæ*.

We have nothing to add to the *Capulidæ* from our S. Indian cretaceous deposits.

* A *Calyptræa calyptrata*, Schrenk, is reported from the upper silurian of Esthland and Russia.

II. *Sub-order*,—Cervicobranchiata.

[Char. *Gill single on the left side of the gill-cavity on the back of neck; teeth in a few longitudinal series, forming arched cross-series of two or three pairs. Shell conical, cup-shaped, symmetrical, with the apex subspiral or simply pointed. (Vide* Gray, Guide, 1857, p. 169).

This sub-order is here introduced simply for the sake of convenience of a sub-division, as it includes all the *Patelli*-form shells, the animals of which only differ from those of the CYCLOBRANCHIATA by their gills being single. Gray includes in it three families, the *LEPETIDÆ*, *TECTURIDÆ* and *GADINIDÆ*. To these the *SIPHONARIIDÆ* may be added, as they agree in most of the important characters especially with the last named family].

XLIV. *Family*,—*TECTURIDÆ*.

H. and A. Adams, Genera I, p. 458; Gray, Guide, 1857, p. 169; *SCUTELLIDÆ*, Chenu, Man. I, p. 374.

The animals of the *TECTURIDÆ* in general very much resemble those of the *PATELLIDÆ*, except that they have the mantle margin not, or only slightly, fringed; the head has a short muzzle, mouth with cartilaginous jaws, tentacles subulate, short, eyes on bulgings at the outer and upper bases of the former; teeth in six longitudinal series, the two inner close, uniform and often larger than the two outer ones on each side; foot large, thick and ovate, usually with an impressed groove in the middle; no operculum.

The shells are depressed, conical, with large open mouth and a subcentral or excentric, more or less pointed and incurved, apex; the muscular impression is interrupted in the region of the gills near the head.

The species are mostly littoral, feeding on seaweeds, or on different marine algæ on the rocks. They are often found, with *Patellæ*, between the tide marks attached to the rocks; being as a rule truly marine inhabitants and numerously represented among living shells. W. Blanford lately described (Jour. As. Soc., 1867, pt. II, p. 62, pl. 13, figs. 2-4) a *Tectura fluviatilis* from the brackish water at the mouth of the Irravadi river, where it usually lives attached to the rocks. The shell is broadly conical, remarkably thin, with very fine radiating striæ and with a decollated apex, as usual in fresh water shells. Another small, capuloid species has been found in the brackish water at Port Canning; it is as yet undescribed.

Messrs. Adams divide the family into four genera (excluding *Lepeta*), namely—

1. *Helcion*, Montfort, 1810.
   1. *a*. sub-genus *Scutellina*, Gray, 1847.
2. *Nacella*, Schumacher, 1817 (H. and A. Adams' Gen. I, p. 467).
3. *Scurria*, Gray, 1847.
4. *Tectura*, Audouin and M. Edw., 1830 (*Acmæa*, Eschholtz, *Patelloidea*, Quoy and Gaimard).

Gray places *Helcion* in the *PATELLIDÆ*, but says that the gills are interrupted over the head, consisting of filiform strands. The form of the latter is very nearly the same as in other *TECTURIDÆ*, and if the teeth do not differ, it would probably be better to retain the genus in this family. Gray also pronounces the genus *Scutellina* to be identical with *Helcion*, from which the shells are not

distinguishable; this seems in reality to be the case, though not as yet supported by the organization of the animals. The genus *Nacella* of Schumacher is apparently correctly placed by the same author in the family *Tecturidæ*. The animals have the mouth entire, not notched, the dentition consists of six series of teeth, and the gills are distinctly interrupted in front of the head. The shell is ovate, conical, depressed and thin, more or less smooth with a sub-anterior apex and on the whole resembles *Helcion*. Gray quotes a species, *Nacella mytiloides*, including, however, others like *N. cærulea*, Linn., under the generic name of *Patina* in the family *Patellidæ*. There seems to be no particular difference between the two species, and H. and A. Adams refer them both to one genus, but place it also in the last named family. Thus all these and other generic distinctions are as yet so very unsettled, that it is most difficult to accommodate to them the numerous fossil species. In consequence of this uncertainty several other new genera (*Tecturella* and others) have been proposed in addition to those already existing, but they are equally ill-defined for the use of the palæontologist. In the greater number of cases indeed it solely depends upon the individual opinion of the author, what he supposes to be a shell of the *Tecturidæ* rather than of the *Patellidæ*. Strictly speaking there are no means of distinction on the shells themselves, and we must be guided, therefore, only by their greater or lesser resemblance to the living species of either of these families. Perhaps we would approach nearest to the truth, by arranging the fossil species according to the following distinctions,—

α, *Helcion*, including forms with an oval or suboval aperture, an excentric, pointed and incurved apex, and the surface covered with radiating ribbings; β, *Nacella*, similar in form to the last, but more depressed and generally smooth on the surface and porcellanous within; γ, *Tectura* including forms with a broadly ovate or circular aperture, apex subcentral, or somewhat anteriorly placed, pointed but not incurved, and the exterior of the shell smooth or covered with radiating striæ which, when present, do not project much on the apertural margin, producing only a slight crenulation of the same;—δ, to *Patella* we would finally refer all those species which are generally somewhat depressed, with an obtusely pointed apex and with strong, more or less unequal and on the margin projecting radiating ribs.

It is of course unnecessary to state that this kind of distinction can only be considered approximately correct, and in fact ought to be resorted to merely in those cases where other and more important distinctions of the shells cannot be traced out. Klein in his Tent. Meth. Ostrac., p. 114, long since proposed in his *Patellæ integræ* and *P. laceræ* a distinction similar to that which we have mentioned as existing in general between *Tectura* and *Patella*.

In a geological point of view the *Tecturidæ* are very important shells, especially because some of the forms externally so closely resemble fossil *Capulidæ*. They are numerous from the Silurian rocks upward all through the secondary and tertiary deposits.

Pictet enumerates in his Mat. Pal. Suisse (3me. Ser. p. 717), 37 European species which he without any further distinction refers to *Helcion*; there are, however, evidently species of *Tectura* and *Anisomyon* (*Lepetidæ*) amongst them, and these have gradually to be separated. Of all the

species, formerly described by different authors from the American cretaceous rocks, Gabb retains under *Helcion* only *H. tentorium*, Mort., and quotes besides three, partly doubtful species of *Tectura*, as *T. occidentalis*, *papillata* and *parva* of Meek and Hayden (see Am. Phil. Soc., VIII, pp. 113 and 138). Lately (Palæont. Calif., 1864, I, p. 141) two new species have been added by the same author, *H. circularis* and *dichotoma*. Guéranger, in his Album Pal. de la Sarthe, 1867, (pl. 14, figs. 21 and 34) gives a figure of *Helc. Orbignyi* and of a doubtful *H. truncatum*, but not of any of the other three species which he names in his Repertoire Paléont., 1853, p. 33. An undetermined species of *Tectura* is mentioned in the 'Paléontologie' of Tchihatcheff's 'Asie Mineure,' etc., (1866, p. 90, pl. 2, fig. 7,) under the name of *Acmæa*. Eichwald (Leth. Ross., XI, lior., 1867, pp. 805-806) describes from the cretaceous rocks of Russia four species of *Helcion*, *H. sulciferum*, *planissimum*, *subtile* and *clavatum*; except the last none of the species can be considered as sufficiently certain with regard to generic determination.

The South Indian cretaceous rocks have yielded us four species, two of which have been already described by Prof. Forbes under the names of *Calyptræa elevata* and *corrugata*. The former was by D'Orbigny referred to *Helcion*, though it seems more likely to be a *Tectura*; the latter is to all appearance a good species of *Helcion*. In each of these genera there is an additional new species described as *Tectura Footeana* and *Helcion carnaticum*. On the whole, compared with other families, the TECTURIDÆ appear to be very rare shells in our cretaceous deposits, for we have seen only single specimens of all these species.

LXXIV. TECTURA, *Audouin and M. Edwards*, 1830.

1. TECTURA (?) ELEVATA, Forbes, sp., Pl. XXVIII, Fig. 6.

1846. *Calyptræa? elevata*, Forbes, Trans. Geol. Soc., Lond., VII, p. 137, Pl. XII, Fig. 10.

Tect. testa late conica, in superficie sublevigata, striis incrementi concentricis, subrugosis notata; apice obtusiusculo, fere centrali.

We have seen in the collection of the Geological Society of London only Prof. Forbes' original specimen of this species from which our figure is taken. The surface of the shell, so far as preserved, is smooth, but there are distinct traces of somewhat irregular, concentric ribbings present. The shell itself is rather thick, as compared with that of *Calyptra* and *Anisomyon*. On the apex, which is very nearly central, the shell is almost entirely removed, but I have not been able to observe any trace of an internal process at this place; I therefore suspect that the species correctly belongs to *Tectura* and not to *Calyptra*; the surface is very much worn off. There seems to be a very shallow depression below the apex, which appears to have been very slightly bent to one side.

It is difficult to understand on what grounds d'Orbigny declared the *Calypt.? elevata* of Forbes, which he quotes as a *Patella!* (Prod. II, p. 232), to be identical with the *Acmea Reussii*, Geinitz. Neither the height of the shell, nor the form of the aperture, or of the apex are in any way identical in the two species; moreover, the last named one appears to be a true *Anisomyon* of the family LEPETIDÆ.

Locality.—Pondicherry, in light coloured bluish sandstone.

Formation.—Arrialoor group.

2. Tectura Footeana, *Stoliczka*, Pl. XIX, Fig. 27.

Tect. testa depresso-conica; apice subcentrali, obtusiusculo; superficie striis concentricis minutissimis atque radiantibus fortioribus ornata, ultimis apicem versus obsoletis, prope marginem tenuioribus alternantibus; apertura continua, ovato-elliptica, ad marginem acuta.

This is a very characteristic oval form; it is much longer than broad; the apex is subcentral, placed a little anteriorly, and somewhat obtuse. The concentric lines are very fine; and at intervals there are stronger, concentric, impressions traceable, resembling slight constrictions and indicating former stages of growth of the shell. The concentric striæ are very thin as compared with the radiating ribs, which near the periphery alternate with shorter ones and are obsolete near the apex. The aperture is entire, with the margin sharpened from within.

Locality.—N. of Comarapolliam; the only specimen has been found attached to a *Tectus tamulicus*, n. sp.

Formation.—Arrialoor group.

LXXV. HELCION, *Montfort*, 1810.

1. Helcion corrugatum, *Forbes*, sp. Pl. XXVIII, Fig. 7.

1846. *Calyptræa? corrugata*, Forbes, Trans. Geol. Soc., Lond., VII, p. 137, Pl. XII, Fig. 11.
1850. *Helcion id.* D'Orbigny, Prod. II, p. 232.
1862. „ *id.* Gabb, Pictet, etc.

Hel. testa conico-elevata, inflata; apice sub-acuto, incurvo, postico; superficie rugis concentricis atque striis radiantibus notata; apertura continua, late ovata seu subcirculari.

The shell is much inflated, elevated, and with a nearly subcircular aperture, the apex is distinctly incurved and placed anteriorly; the concentric wrinkles are very distinct, numerous and towards the apex broader, though not more elevated; of the fine radiating lines there are only a few traces preserved on the original specimen, which I examined in the Geological Society's Collection of London. There is no other cretaceous species known, which could be compared with our fossil.

Locality.—Near Pondicherry, in light coloured, calcareous sandstone.

Formation.—Arrialoor group.

2. Helcion Carnaticum, *Stoliczka*, Pl. XIX, Fig. 26.

Hel. testa subconica, elevata; apice obtuso, excentrico, postice paululum incurvo; superficie costulata, striis radiantibus circiter 16 *fortioribus, atque numerosis interpositis tenuissimis notata, omninis in superficie subrugatis; apertura ovata.*

This species is based upon the single figured fragment, which has been found in the Arrialoor sandstone near Comarapolliam, but as the ornamentation of the shell is very characteristic, we distinguish it under a separate specific name. The

radiating ribs, of which about 16 are much stronger than the rest, are intersected by very fine concentric striæ which thus produce a fine granulation on the former. The apex is obtuse, but somewhat worn off on our specimen, posteriorly slightly incurved.

Locality.—Comarapolliam; apparently very rare.

Formation.—Arrialoor group.

XLV. *Family,—GADINIIDÆ.*

H. and A. Adams, Genera I, p. 462; *Gadiniadæ*, Gray, Guide, 1857, p. 172; Chenu, Manuel, I, p. 375.

The living species of the genus *Gadinia* are distinguished by their largely developed, funnel-shaped tentacles, with eyes sessile on the sides of their base; the gills are single, placed obliquely across the back of the neck, in form and position resembling those of the *Tecturidæ* and *Lepetidæ;* the foot is flat, thin and simple.

The shell is very much like that of a *Patella*, being *depressedly conical, with a more or less roundish aperture, internally with a marginal horse-shoe-shaped muscular impression, and with a groove in front of the right side not being, however, distinctly marked on the external surface.*

Prof. Pictet mentions (Traité de Pal., Vol. III, p. 293), that the Mediterranean *Gadinia (Gardinia) Garnoti, (Pileopsis id.* Payradeau,) occurs fossil in the quaternary deposits of Sicily. There are besides some other fossil forms, which appear to belong to this family. Chenu associates in it the jurassic form *Deslongchampsia*, M.'Coy, which is distinguished by a scar running from the apex to the margin, towards which the former is slightly incurved; on the margin itself the scar is produced spoon-shaped. There are at present, I believe, only three jurassic species known, *Desl. appendiculata*, Desl., *Desl. Eugenii*, M.'Coy, and *Desl. loricata*, Laube, (Sitzgsb. Akad., Wien, 1866, LIV, Gastropoden des braunen Jura., etc., p. 2. I may, however, draw attention to certain cretaceous species, like *Emarginula Villersensis*, Pictet and Camp., (Mat. p. l. Pal. Suisse, 3me. Ser., pl. 97, fig. 13), which appears to have had a scar on the same (anterior or ? posterior) side towards which the apex is incurved. There is no sign of a slit visible on the cast, the shell itself not having been as yet found preserved. There are also a few palæozoic *Patellæ* known, like *P. scutellum* (Eichwald Leth. Ross. 1860, Vol. I, p. 1097, pl. 41, fig. 17), which very much recall the form of *Deslongchampsia* by their elevated and obtuse apex.

Another genus which may belong to this family is *Metoptoma*, Phillips, (Yorksh. pt. II, 1836, p. 223), having a shell like *Helcion*, with a broad but slightly or obsoletely marked scar below the apex, truncate or somewhat insinuated on the margin. Chenu quotes *Metoptoma* as a synonym of *Deslongchampsia* which cannot be admitted. The *Pat. solaris*, Koninck, of which he gives a figure on p. 376, is a true *Metoptoma*. Some other species are described from the mountain

limestone by Phillips. Hall also refers a few silurian species from America to the same genus, and Eichwald (Leth. Ross., Vol. I, 1860, p. 1098) describes several palæozoic species some of which, like *Met. solare* (*non id.* Koninck), are covered with radiating ribs.

Except the remarkable *Capulus Troscheli*, Müller, from the Senonien deposits of Aachen, I am not acquainted with any cretaceous species which would particularly resemble the palæozoic *Metoptomæ*.

XLVI. *Family,—LEPETIDÆ.*

Gray, Guide, 1857, p. 172 ; H. and A. Adams, Gen. I, p. 462.

This small family includes only a few species which H. and A. Adams noted under the genus *Lepeta* and the sub-genus *Iothia* in the family *Tecturidæ*. *The lingual riband has one central tooth, like that in the Capulidæ, but only two lateral teeth on each side instead of three, and all of them are of a somewhat different shape.* The animal otherwise resembles that of the *Tecturidæ*, but according to Gray many of the species are not known to possess eyes, and the gills are said to be often rudimentary, although Forbes and Hanley (Brit. Shells, Vol. II, p. 443) speak of a *branchial plume* (two plumes ?) being *cervical*. Judging from the great depth out of which *Lep. cæca*, Müller (*Propilidium ancyloide*, Forbes) is generally dredged alive, we may suppose that gills can scarcely be wanting.

The shell of the *Lepetidæ* resembles that of some *Capulidæ* with subspiral apex. From *Helcion* it is distinguishable by the horse-shoe-shaped muscular impression in the interior of the shell. This last character shows that the family is closely allied to the *Capulidæ*.

Gray quotes in it two genera, *Lepeta*, Gray, and *Iothia*, Forbes. Of the first, according to H. and A. Adams, there are four,* and of the latter only one living species known. The fossil ones can only with great difficulty be distinguished from *Capulus*, *Cochlolepas*, *Helcion*, *Tectura* and others, unless the thin shell is perfectly well preserved.

We only know a small number of cretaceous shells which strongly recall the characters of some of the recent *Lepetidæ*, and which have been named by Meek and Hayden *Anisomyon*† (Am. Jour. Sc. and Arts, 1860, XXIX, p. 35). The species attributed to this genus are principally distinguished from *Patella* and *Cochlolepas* by their thin shells ; the apex is curved backward as in *Lepeta*, but not spiral as in *Capulus;* the internal muscular impression is horse-shoe-shaped and is interrupted in front as in *Lepeta*. The exterior surface of the shell is generally smooth, with distinct lines of growth, but not often with radiating striæ.

* Lovén proposed (vide Vetensk. Akad. Forhandl., 1859, p. 119) for the *Pilidium commodum*, Midd., the name *Piliscus*, and describes another species *P. probus;* both ought to be placed in the *Velutinidæ*. The determination of the species as well as that of the genera is in fact rather uncertain.

† Some of the species of *Anisomyon* exhibit a great relation to species of the palæozoic *Cyrtolites*, like C. ? *expansus*, Hall, (Pal. New York, III, p. 479, pl. 114, figs. 4–5).

The only objections which could be raised against the classification of the genus in this family would lie in the supposed small opening of the apex, which, if present, would refer *Anisomyon* to the *Fissurellidæ*. The existence of a perforated apex is, however, by no means settled, and from its length it would appear more likely that its point was broken away. On the other hand its thin shell very much recalls similar forms of *Umbrellæ* and other Pleurobranchiata. Gabb quotes in his Synopsis of American fossils (Am. Phil. Jour. 1861, VIII, p. 94), the following six species, *Anisomyon alveolatus*, M. and H.; *A. Shumardi*, M. and H.; *A. borealis*, Mort.; *A. patelliformis*, M. and H.; *A. sexsulcatus*, M. and H., and *A. subovatus*, M. and H., (for other references see Proc. Acad. Nat. Sc. for 1860, p. 423). To these is to be added *A. Meekii*, Gabb (Pal. Calif. I, 1864, p. 142, pl. 21, fig. 105). Meek, (Check list, cret. foss., 1864, p. 17) has an *A. Haydeni* and a doubtful *A. ? inæquicostatus (Scalpellum id.* Shumard). The same author quotes an *A. alveatus*, M. and H., which is probably a misprint for *A. alveolatus*.

The genus *Anisomyon* is classed by Meek in the family *Tecturidæ;* at present only American species have been recorded under this name, but there is a large number of fossils known from the cretaceous beds of Europe, described under *Helcion*, *Acmæa*, *(Tectura)* and *Patella*, which when found in better preservation and after having been more carefully examined, will largely increase the number of species belonging to this genus.

XLVII. *Family,—SIPHONARIIDÆ.*

H. and A. Adams, Genera, II, p. 268; Deshayes, Anim. s. vert. foss. Paris, II, p. 687, etc.

The distinctions between the animals and shells of *Gadinia* and *Siphonaria* do not seem to be so very great as to indicate the separation, which has been proposed for the two respective families by the authors of the "Genera." H. and A. Adams transfer, namely, *Siphonaria* to the neighbourhood of *Ancylus* and *Amphibola*. The tentacles of *Siphonaria* are thickened and expanded, forming a sort of fleshy disk, and having the eyes sessile near their base, or at their outer margin. Their expansion is generally not stronger, or scarcely stronger, than in *Gadinia*, only that they are less distinctly separated than in the last genus. The branchial plume – if it really deserves that name – is single, running across the back, but the respiratory opening which is placed anteriorly on the right side, is covered by a fleshy lobe of the mantle, and the presence of this lobe is, strictly speaking, the only remarkable difference between the two families. The foot forms a tolerably expanded, oval, fleshy disk. The teeth are numerous, sub-equal, arranged in slightly curved cross-lines: the central tooth being narrow, elongated, with a small rhombic apex; the lateral teeth larger, diverging and furnished with curved tips. The teeth of *Gadinia* are as yet not known and cannot, therefore, be brought in support of the relations of the two families. The shells of *Siphonaria*, the only genus known as constituting the family, are *depressedly conical and usually*

provided with radiating ribs, like Patella; apex sub-central, obtusely pointed; aperture more or less oval, or irregularly roundish, the margin generally being interrupted by the projecting ribbings; the siphonal groove is usually placed in front on the right side, and is on the external surface often marked by two closely placed ribs, which project beyond the margin more than the rest; the muscular impression is interrupted on the siphonal groove.

It is evident from these general characteristics, that the only shells related to *Siphonaria* are *Gadinia* and *Deslongchampsia*. The species are principally inhabitants of the tropical seas; they do not differ in their mode of living from *Patellæ*, being found between tide marks attached to rocks. They also often remain for some time above the low tide, and it is probable that on this account they develope a separate lobe with which to close the respiratory orifice, so as to prevent the drying of the gills. Such changes in the organization are by no means unusual, and they no doubt form the basis of all the distinctions which we have to trace out, and on which we base our classification of the orders, families and genera. It is not clear from the account given by Quoy and Gaimard (Voy. d'Astrolabe, Zool. Vol. II, p. 323, etc.) that the animals are really air-breathing, though they seem to be in some respect amphibious, like *Ampullaria* and others, as might evidently be expected from their mode of living. The lungs or rather a portion of the respiratory sac is said to assume its functions when there is no sufficient moisture for the gills. In spite of these differences in the respiratory organs I do not think, that the family could be placed more naturally anywhere else than next to the *Gadiniidæ*, *Tecturidæ* and *Lepetidæ*.

There are as yet only a few tertiary species of *Siphonaria* known, though some of them appear to have been described under the name of *Patella*. The first and only well known cretaceous species is the *Siph. antiqua*, Binkhorst (Gast. et Ceph., Limbg., 1861, p. 60, pl. 4, fig. 3; and pl. 5, fig. 5). We have not obtained any species from our cretaceous deposits in South India.

III. *Sub-order*,—Cyclobranchiata.

Patellidæ, H. and A. Adams, Gen. I, p. 463; Gray, Guide, 1857, p. 173; Bronn, Klassen und Ord., Vol. III, p. 1034; Deshayes, An. s. vert. foss. de Paris, II, p. 220.

This small group of animals is characterized by the form and position of their gills, which are lamellar and placed on the inner surface of the mantle, between it and the foot. Gray's remark that "the gills are only an elongated branchial plume springing from the neck", and that they "ought not to be looked on as a pair of symmetrical, sub-semicircular laminæ, as in the Cyclobranchiate Chitons," is of great interest. It is true that the gills of the Cyclobranchiata are not placed in a separate respiratory cavity, but there cannot be a question that they otherwise very much resemble those of some *Tecturidæ*; there are in fact instances where a distinct separation between the Cervicobranchiate—and the Cyclobranchiate—form is almost impossible to accomplish; beyond certain limits

they pass one into the other. As soon as we know more of the form and the position of the gills in the numerous and different species of the CYCLOBRANCHIATA, it may very likely be shown that the distinction of the two last sub-orders is not necessary, but there are many difficulties as yet to be overcome. Gray proposed the name HETERODONTA and Mörch that of ORTHODONTA; Troschel introduced the name DOCOGLOSSA including in it, beside this and the former sub-order, also the CHITONIDÆ or POLYPLACOPHORA and the DENTALIIDÆ or SCAPHOPODA, (vide Archiv für Naturgesch., 1866, XXXII, p. 257).

A more detailed description of the form of the animals, their dentition, &c., will be found in the treatises of H. and A. Adams, Gray, Troschel and others.

XLVIII. *Family,—PATELLIDÆ.*

Having excluded the POLYPLACOPHORA and the SCAPHOPODA there only remains one family to be mentioned, and several conchologists even object to recognise more than one genus, *Patella*. It is well known that in all the species of Mollusca, which generally live attached to foreign objects, small variations in the form of the shells occur, and that therefore the exact form of the shell has not the same generic value as is the case in other free-living species. Still when a portion of the shell is regularly produced to so great an extent as in the *Pat. cochlear*, Gmel., a generic or sub-generic distinction appears desirable. Gray quotes four genera, two of which, *Nacella* and *Helcion*, have been placed in the *TECTURIDÆ*.

1. *Patella*, Linn., 1752. *Shell depressedly conical with suborbicular or oval aperture, sub-anterior apex, and externally usually covered with radiating ribs, which project more or less on the margin (vide* antea p. 321). There are only a few finely striated species known, and even regarding these it is not quite certain whether they do or do not belong to the *TECTURIDÆ*. In fossil shells the presence of stronger projecting ribs is almost the only, at least approximately correct, distinction between *Patella* and *Tectura*.

1a. *Olana*, H. and A. Adams, 1855, proposed for *Pat. cochlear*, Gmel., having the anterior portion of the shell much produced. The animal is not different from those of other true *Patellæ;* the shell resembles that of some of the fossil *Metoptomæ* (vide antea, fam. *GADINIIDÆ*). *Nacella*, Schumacher, (*Patina*, Leach apud Gray,) and *Helcion*, Montf., which have the gills composed of filiform strands not of lamellæ and interrupted over the head, have been, as already noticed, placed in the *TECTURIDÆ*.

The habitat of the *PATELLIDÆ* is well known; they are always found on rocky coasts. Fossil species occur, though not very numerously, through all the sedimentary deposits from the oldest to the upper tertiaries. Some palæontologists, however, prefer to call the palæozoic and older secondary species by different names, and place them in different families. Pictet and Campiche, in their list of cretaceous species (Mat. p. l. Pal. Suisse, 3me. Ser., Foss. Ste. Croix, p. 721),

have evidently followed Gabb's propositions (Am. Phil. Soc., Vol. VIII, p. 122), and transferred all the known species of *Patella* and others to *Helcion*. It is true that very few of the species among those described as *Patella* seem in reality to belong to this genus, but we do not understand for what reason species like *Patella campanulata*, Geinitz (Reuss, Boehm. Kreide, II, pl. 44, fig. 9), and a few others are transferred to *Helcion*. Gabb (Palæont. Calif., 1864, I, p. 140, pl. 21, fig. 103,) lately described a *Pat. Traskii* from the Californian cretaceous deposits.

LXXVI. PATELLA.

1. Patella ? sp., Pl. XIX, Fig. 23.

We have obtained from the South Indian cretaceous rocks only one specimen, which appears to be a *Patella*. The representation given on Plate XIX only shows the internal view of the specimen, which is ovately elongated with a subanterior apex. The anterior margin of the shell is entire, though there appear to be traces of external ribs perceptible. Posteriorly the shell is much produced, somewhat expanded and terminates with four strong ribs, the inner pair of which is more prolonged than each of the outer ones. The edge of the aperture is otherwise sharp, and the internal structure not differing from that of other *Patellæ*. Except a few continuous furrows indicating different stages of growth, there is nothing distinctly traceable of a muscular impression. The specimen is so thoroughly imbedded in a calcareous rock that it is impossible to obtain a view of the smallest portion of its outer surface. It will suffice for the present to draw the attention of any future observer to this interesting species. With respect to its general form we could only suspect, that better specimens may possibly show the species to be an *Amathina* (fam. *Capulidæ*), though the internal view of the apex gives little support to this determination.

Locality.—East of Odium.

Formation.—Ootatoor group.

IV. *Sub-order*,—Scutibranchiata.

Char. Prosobranchia with gills consisting of one plume, which is formed of two equal series of lamellæ and is placed on the left side in a cavity over the back of the neck; heart traversed by the rectum; sexes distinct, but the males are said to have no external copulative organs developed; lingual teeth distinguished by a large number of uniform lateral ones.

Shell spiral, depressed or conical; aperture with the margins entire.

We here restrict the name Scutibranchiata to those shells only, the animals of which possess one branchial plume consisting of two series of lamellæ, and are thus readily distinguished from those of the Pros. Ctenobranchiata, in which the plume is provided with a single series, or if a second one be present,

it is only very small and rudimentary. The heart, which is traversed by the rectum, is generally somewhat unsymmetrically formed, apparently on account of the unilateral development of the gills. The head is distinct and provided with a short annulated rostrum, which is said to be retractile in the *Rotellidæ*. The very large number of small and similarly formed lateral teeth on the radula are a peculiar distinction of all the animals, but this is also common to the Fissobranchiata and to the *Helicinidæ*, all of which, including a few other families, are classed by Prof. Troschel in the sub-order Rhipidoglossa. The tentacles are long and the eyes placed on more or less prolonged peduncles (Podophthalma, H. and A. Adams, Gen. I, p. 377). The foot has always a well developed creeping disc.

It is also usually stated in conchological books that the Scutibranchiata (as restricted) are hermaphrodites, though that does not appear to have been as yet fully ascertained. Later researches, moreover, have shown that the sexes are distinct, but that external copulative organs are generally wanting in the males. Both the sexual organs are said to be so very similarly constructed, that they seem to have misled former observers, and it consequently must depend now upon further observations, whether the opinions of older authors, or those of later years, be confirmed. According to the presence or want of certain appendages on the sides of the foot and above the head, and also with respect to a difference in the structure of the shells, I shall separate the Scutibranchiata into two divisions, the one including the family *Neritidæ*, and the other all the species which are generally united in the family *Trochidæ*. Gray has already proposed these sub-divisions of the Scutibranchiata, in his catalogue of 1857 (p. 13, etc.), but he, as likewise H. and A. Adams, at the same time included in them a few genera, which I believe to be more correctly placed in the next sub-order.

All the Scutibranchiata are littoral, vegetable feeders, and their radula has consequently a great length.

I. *Tribe*,—Planilabiata.

Foot of the animal simple, without any lateral appendages; internal layer of the shell porcellanous, outer layer calcareous, generally thin where an epidermis is present, inner lip callous, expanded and always flattened, with a more or less sharpened edge.

We have at present only to notice one family as belonging to this tribe.

XLIX. *Family*,—*NERITIDÆ*.

H. and A. Adams, Gen. I, p. 377; *Neritinidæ*, Gray, Guide, 1857, p. 136; *Neritacea*, Philippi, Handbuch, p. 201.

Shell spiral, semiglobose, depressed with a short lateral spire, which is sometimes perfectly incrusted by an external callosity, not umbilicated; aperture more or less

semi-circular, outer lip sharpened from within, inner lip usually with a toothed or plicated edge. Operculum shelly, subspiral, with a process on the inner edge.

All the *Neritidæ* absorb the internal portions of the upper whorls, either partially, or wholly, producing thus a simple cavity which occupies the top of the shell. This is sometimes important in the determinations of cast specimens, which can thus be readily distinguished from those of the *Naticidæ* by the want of any spiral apex.

The animals of the *Neritidæ* are distinguished by the great length of their setaceous tentacles and by their large triangular or roundish foot, which has no lateral fringe-appendages, nor any kind of filaments; the head- or neck-lobes are also wanting. The rostrum is short, broad and flattened; the radula very long, the middle teeth unequal, the second and fifth on each side being much larger, than the central and the third and fourth lateral ones; the other lateral teeth are uniform, thin, very numerous and hooked at the tip.

It is remarkable how very much the animals of the *Neritidæ* resemble those of many *Helicinidæ*, and the dentition so far agrees in both, that the lateral teeth are very numerous and uniform, but the central ones of the latter are very different from those of the former. The form of the shells, with their non-umbilicated and flattened inner lips, is also similar in both families. Troschel and other conchologists classify, therefore, the *Helicinidæ* next to the *Neritidæ*, in the sub-order Rhipidoglossa. We have for the present no materials either to confirm or to oppose this classification. If, however, the dentition is to be considered as the principal basis of a higher classification, the place assigned to the *Helicinidæ* by Troschel has good grounds. It is by no means very improbable, that the *Helicinidæ* represent by a series of more highly developed forms that group of shells to which also the *Neritidæ* belong. Thus, comparing the marine and fresh-water species of the *Neritidæ* and those of the *Helicinidæ* we have only a repetition of the same, or very similar, structural transformations or changes in the shells and animals, as I have previously noticed in the *Rissoidæ*. I then stated that the study of such gradual changes in the organization of the animals,– and in their shells as connected with this,– is the only way in which we can hope to arrive at a natural system of Mollusca. It is no doubt quite evident, that in tracing out these natural groups of shells, the distinctions based upon the differences in the respiratory organs must become of subordinate importance. But on the other hand it is as yet not proved, whether the form of the dentition will offer us a better and more reliable basis for classification. It is well known, that the dentition is in some cases very variable among similar species, while in others it appears to be very constant. Every new discovery shows, that we must base our classification upon a summary of characters, and must as much as possible avoid giving to single distinctive characters a general meaning.

It is known that the respiratory cavity is placed on the back of the neck exactly similarly in the *Neritidæ* and in the *Helicinidæ*. Supposing, for instance, that further examinations of the animals of the *Helicinidæ* should show, that

there are among them species to be found which still possess rudiments of gills, such a case would immediately remove all the doubts which can at present be raised against the classification of the two families in one division. The name PLANILABIATA which we have suggested would be characteristic for both; and a few other allied forms which are for the present classed in the NEUROBRANCHIA probably could be placed in the same tribe.

The *NERITIDÆ* are partially marine and littoral, partially brackish- and fresh-water inhabitants. The marine species generally have a thicker shell than the others, but the general form of both is very much alike.

Fossil species of *NERITIDÆ* occur all through the sedimentary formations, but they are never very numerously represented, as compared, for instance, with species of *NATICIDÆ* or *TROCHIDÆ*. With reference to the small number of palæozoic species, Deshayes (Paris foss., 2d. edit., Vol. III, p. 12) correctly remarks, that they require to be carefully re-examined, to render their generic determination indisputable. It is, indeed, very much to be regretted that so little attention is occasionally paid to the form of the aperture, especially to that of the inner lip; and that specimens are simply determined as *Neritæ* from an external resemblance of form. There is very little to be learned from a figure which is merely a representation of the back-view of a specimen; and still such so-called species are often successively transferred to half a dozen different genera, without the slightest further contribution towards a knowledge of their generic characters.

True species of *NERITIDÆ* are known from the Trias, and from that time their number gradually increases in the successive secondary strata, until they reach their maximum in the present time. It is remarkable that most of the oldest, triassic species are smooth, like *Neritinæ*, though they always have the thick shell of *Nerita*.

There has already been so much written about the generic or sub-generic distinctions in the family *NERITIDÆ*, that we hardly need to repeat here the controversies which are to be found in the different treatises on conchology. So far as concerns the specific forms, which are pretty well known, there cannot be a doubt that it is very desirable to make certain generic distinctions among them. The two groups of shells, usually quoted under the names of *Nerita* and *Neritina*, can generally be separated without difficulty. To determine, however, the other genera correctly we still very much require a knowledge of the organisation of the animals. It is simply impossible to imagine, that identically organised Molluscs produce a different structure of the external shell; for if these differences originated in a change of their habits and manners of life, they would only prove that the influence of external agencies has already effected a change in their organisation. Unless, however, we distinctly point out the organs which produce these structural changes of shell, and what value may be attached to them in the classification, we cannot expect our generic and sub-generic names to be of any permanent use. A trinominal nomenclature would very much assist us in such cases. Excepting in the *AMMONITIDÆ*, there are not many other instances,

or examples known in which conchologists would better see the great advantage deriveable from such a trinominal designation; or in other words, from the proper use of sub-generic distinctions. The natural grouping of shells would certainly derive from its use greater benefits, than could be counterbalanced by the slight inconvenience which it would possess as compared with the binominal system.

We give here a short summary of the different generic and sub-generic forms known up to the present.

1. *Navicella*, Lamarck, 1809. (*Catillus*, Humphrey apud H. and A. Adams, Gen. I, p. 386; Gray, Guide, 1857, p. 139,) is the patelliform representant of the family; only one or two sub-fossil species have as yet been reported.

2. *Pileolus*, Cookson, 1823, is known only in a fossil state. The secondary species have the basis generally rounded and the apex subcentral, while the tertiary species have it more oval and the apex terminal. These last named species approach, therefore, pretty nearly the recent *Navicellæ*, and Deshayes remarks that the name

2a. *Tomostoma*, which he proposed in 1823 (publ., 1824) might be applied to these tertiary species (vide Paris foss. 2d. ed., Vol. III, p. 25).

3. *Neritina*, Lamarck, 1809. (*Neritella*, Humphrey in H. and A. Adams' Gen. I, p. 380; Gray' Cat., p. 137). Nearly all *Neritinæ* live in brackish- or fresh-water, and are generally covered with a horny epidermis. The typical species have a distinct, shortly conical spire, the shell is thick and globose, the edge of the inner lip insinuated, more or less distinctly denticulated.

The following forms have been distinguished as sub-genera :—

3a. *Velates*, Montfort, 1810 (vide Chenu's Man. I, p. 337). According to Deshayes the spire is distinctly traceable in young specimens, and becomes enveloped with callosity only in later stages. The typical species, *Vel. Schmideliana*, is distinguished by its broadly conical form, large extent of the inner lip, and its strong denticulation along the entire inner edge of the aperture.

3b. *Neripteron*, Lesson, 1830, has the external edges of the apertural margin posteriorly and anteriorly much expanded; the form is depressed with a subposterior and lateral apex; edge of the inner lip denticulated.

3c. *Alina*, Recluz, 1842; in form like the last, but the margin has only the upper or posterior external edge expanded.

3d. *Dostia*, Gray, 1840. Shell oval, depressed with lateral incurved apex. If Humphrey's name *Neritella* has any right to be accepted, it could apply only to this form.

3e. *Vitta*, Klein, 1753. Shell transversally oblong with a short indistinct spire, slightly or obsoletely toothed on the edge of the inner lip.

3f. *Clithon*, Montfort, 1810 (H. and A. Adams, Gen. I, p. 384,) includes a number of species which usually have some kind of spines or tubercles on the posterior portion of the whorls. These spines generally only develope in old specimens, being often wanting in the young stages. A more useful characteristic of *Clithon* is the invariable presence of a strong fold-like tooth on the inner lip, being

placed either posteriorly or near the middle of its edge, which is otherwise smooth or finely denticulated throughout its entire extent.

4. *Nerita*, Adanson, 1757 (H. and A. Adams, Gen. I, p. 378; Gray's Guide, p. 136, and Chenu's Man. I, p. 333; *Otostoma*, d'Archiac—*ex parte ?*). Adanson and not Linné is the author of the genus *Nerita*, because the former first determined the genus with the greatest precision, so that hardly any subsequent changes have been required.

The *Neritæ* are distinguished by the great thickness of the shell, especially on the inner side of the outer lip, and generally by the small number of teeth on the inner one. Several sub-genera have been noticed by H. and A. Adams, but I do not think that these can be so well defined as those of the *Neritinæ*. They call the depressed species with a smooth inner lip *Nerita*. *Theilostyla*, Mörch, 1852,—or rather *Dontostoma*, Klein, 1753 (Ostrac. p. 16, pl. I, fig. 29)—are similar in form but have the inner lip granulated, and *Pila*, Klein,—or *Peloronta*, Oken,—has the inner lip irregularly striated, provided with few fold-like teeth, and the spire of the shell short and pointed.

A comparison of a large number of different species shows, however, that these sub-generic groups can be used only in a very general way, even admitting that there are some other minor distinctions present; for there are specimens of the same species to be found, some having a granulated, others a smooth, and again others a partially striated inner lip.

Visc. d'Archiac proposed in 1859 (Bull. Soc. Géol. Fran., XVI, p. 871) the name *Otostoma* for a number of fossil species, which do not appear to be essentially different from *Nerita*. I have already in my 'Revision der Gosau-Gastropoden', p. 47 (Sitzb. Akad., Wien, 1865, Vol. LII,) stated, that the species referred by d'Archiac to *Otostoma* are probably nothing more than incomplete *Neritæ*. Looking now at the state of preservation of several specimens of our *Nerita divaricata* and *Carolina*, I cannot but confirm my previous suppositions. I may, however, take this opportunity to enter a little more fully into this subject.

Leidholt, G. Rose, and others have shown some years ago, that those shells which consist of arragonite very often disappear in a fossil state, leaving nothing but casts, while those consisting of calcite are preserved. Sorby confirms (Brit. Ass. Report 1862, pt. II, p. 95) these statements by additional and new observations. He says that the alteration of arragonite shells 'appears to depend on the fact of the particles of arragonite being in a state of unstable equilibrium. When prepared artificially, it has a great tendency to pass into calcite; and if this change took place in shells, their organic structure would be very apt to be destroyed, though the shell might remain as a crystalline mass of calcite. If, however, the circumstances of the case were such, that the calcite, formed at the expense of the arragonite of the shells, had a greater tendency to crystallize elsewhere rather than *in situ*, they would be removed and leave more or less perfect casts. On the contrary, calcite having no such tendency to change, shells composed of it might, under similar conditions, remain nearly in their original state.'

The shell of all *Neritidæ* consists of two very distinct layers, which are especially well developed in most of the typical marine species of *Nerita*. The outer layer is a white milky substance with rhombohedral fracture, like calcite; the inner one, usually known as the inner callosity of the shell, is in recent species of *Nerita* a more or less homogeneous, transparent mass. Before the blowpipe both layers of the shell stand the heat equally well, and are reduced to quicklime; from which it would appear, that they are both calcite. I have at least no direct means at present to show that the inner layer is arragonite, for only the pure crystalline masses of this mineral seem readily to fall to powder when exposed to heat. Impurer masses of arragonite do not fall to powder before the blowpipe, or at least not so readily.

It is certain that the inner layer of the shell of the *Neritæ* is even to the naked eye very different from the outer one, and whether it be arragonite or calcite, the statement of Mr. Sorby, that the particles are in a state of a certain unstable equilibrium, appears to be thoroughly applicable to our case. In several of our specimens of *Nerita divaricata* the inner or callose layer of the shell is changed into an aggregate of well developed crystals of calcite; (vide Pl. XXVIII, Fig. 5); in other specimens it has partially or perfectly disappeared. In both these cases the outer layer remains perfectly unchanged. This is therefore fully in accordance with Mr. Sorby's statement, which I have quoted above, namely, that the shell may either remain '*as a crystalline mass of calcite*', or, under certain circumstances, be '*removed*' altogether. This removal of the inner layer of the shell produces, however, a remarkable change in the appearance of the shell, inasmuch as it loses all its distinguishing generic characters. A thick and massive shell provided with a large flattened, dentated inner lip and a narrow aperture becomes thin, without a trace of any thickening and with a very large roundish aperture like a *Velutina*. A glance at Binkhorst's figure 1 b, of *Nerita rugosa* (Monog. Gast. et Ceph. de la craie de Limbg., 1861, pl. 5a,) shows very clearly the thickness of the callous layer which has been dissolved away, and at the same time the remarkable difference in the aspect of the shell (see also *ibidem*, pl. 3, fig. 15c). I may remark that the removal of the callous layer appears to have taken place in some instances by such a gradual and slow process that its place has been taken by the surrounding rock, without producing the slightest change in the external form of the shell. It is in such cases extremely difficult to detect, in these apparently well preserved shells, species of *Nerita*.

The *Ner. rugosa*, which was generally described as a *Natica*,—until Mr. Binkhorst discovered the internal casts of the shell,—was one of the three cretaceous species upon which Visc. d'Archiac based his genus *Otostoma*. Even in Tchihatcheff's 'Asie Mineure, Paléontologie,' 1866, p. 89, the same species is retained under the generic denomination of *Otostoma*, though with a query, but without making reference to Mr. Binkhorst's well known discovery! With regard to the *Nerita rugosa* from Maestricht, *Ner. nodosa* (*Natica id.* olim) from Bohemia and Saxony, *Ner. Zekeliana* and *Ner. Hörnesiana* (*Natica rugosa* and *Hörnesana* of Zekeli)

from the Gosau; the *Ner. rugosissima*, Forbes, from India and others, which I have had the opportunity of examining, there cannot be the least doubt that they are – generally speaking – true *Neritæ*, and that the occasional want of the inner lip and of the callosity of the shell is to be attributed to the causes mentioned above.

Now comparing with these data d'Archiac's figures of the four other species of *Otostoma*, two of which are eocene, I cannot help thinking that they are nothing more than incomplete specimens of *Neritæ*, in which the inner layer of the shell with the entire callosity of the inner lip has disappeared. It is not impossible that such shells, as Visc. d'Archiac wished to refer to his *Otostoma*, may have existed; but after the numerous and repeated observations which I have made on the previously named species* I cannot but doubt their real existence. Still I do not wish to go beyond actual observation of facts, and I leave the decision, as to the other four species of the so-called *Otostoma* (as well as the two described by Coquand from Algiers) to any one who may have an opportunity of examining the original specimens. When lately myself at Paris, I felt very sorry that I could not during the short time of my stay succeed in obtaining access to the specimens which were collected by Mr. Tchihatcheff.

There is only one point to which I would wish to direct attention. Comparing the species, which I will mention subsequently under the numbers 9-25, there may be observed in all of them a remarkable similarity in ornamentation,– consisting of transverse ribs on the posterior and a spiral sulcation on the anterior half of the last whorl—, in the great thickness of the shell and in the large size of the inner lip, which is smooth, reaching very low down in the space of the aperture, and having on its margin generally a number of eight equally strong teeth. The recent *Neritæ* have usually a narrower and less precipitous inner lip and a smaller number of teeth. Thus it is still possible that, *mutatis mutandis*, *Otostoma* may appear among the sub-generic divisions of *Nerita*.

5. *Deianira*, Stoliczka, 1860 (Sitzb. Akad., Wien, XXXVIII, p. 488). Shell sub-globose, consisting of few whorls, the last of which is the largest, often carinated posteriorly; aperture large, semilunar; inner lip thick with three folds, the posterior one of which is the strongest. Operculum broadly oval, calcareous, with a tooth on the inner edge, and a groove corresponding to the strong posterior fold of the inner lip.†

The strong posterior fold of *Deianira* is similar to that of *Clithon*, but the want of any finer denticulation distinguishes it readily from the *Neritinæ*. The genus was proposed for two species, *Dei. bicarinata* and *Hörnesi*, from the cretaceous fresh and brackish-water deposits of the North-Eastern Alps; the former was first described by Zekeli as a *Rotella*. In my revision of the Gosau-Gastropoda, p. 50 (Sitzb. Akad., Wien, 1865, Vol. LII) I have added the *Deianira Goldfussi*,

* Our nummulitic species show the same different state of preservation.

† The position of the operculum in the aperture is very likely quite similar to that of the *Neritinæ*, not that the tooth, as I supposed (l. cit.), would correspond to the posterior edge of the aperture.

Kefst., sp., which was long before known as *Nerita Goldfussi=N. cingulata*, Reuss, and which is distinguished by its granulated surface, while the two former species are smooth.

6. *Deshayesia*, Raulin, 1844 (*vide* Deshayes in An. s. vert. foss. de Paris, 2d edit., Vol. III, p. 82). We cannot agree with Deshayes' statement, that this genus should be classed in the *Naticidæ* instead of in the *Neritidæ*. It is true that the general form of the shell resembles some of the globose species of *Natica*, as the upper whorls are convex, the spire distinct, and the basis of young specimens slightly umbilicated. The typical species of *Neritina* show us, however, forms which are very similar to those of *Deshayesia* with regard to the form of the spire; the umbilicus also is not always perfectly covered by the inner lip in immature specimens. The flattened form and the denticulations of the inner lip, as well as the internal thickening of the outer one, can be, however, only compared with similar forms of the aperture of the *Neritidæ* and not with those of the *Naticidæ*.

Two or three species of *Deshayesia* are known from the tertiary strata, and one species, *Desh. Rauliniana*, Ryckholt, from the devonian is doubtfully referred to this genus.

7. *Neritoma*, Morris, 1849 (Quart. Jour. Geol. Soc., London, V, p. 332), has been proposed for two jurassic species, *N. sinuosa*, Morr., and *N. bisinuata*, D'Orb., sp., both of which have the general globose form of *Nerita*, a flattened, not denticulated, inner lip and in a mature state a posterior slight insinuation of the outer lip.

The cretaceous species of the *Neritidæ*, so far as known, belong to the following genera and their sub-divisions:—

1–3. *Pileolus Urgonensis*, P. and C., *Michaillensis*, P. and C., and *cretaceus*, D'Orb., vide Pictet and Campiche, Pal. Suisse, 3me. Ser., p. 413.

4. *Pileolus Cenomanensis*, Guéranger, Album paléont. d. l. Sarthe, etc., 1867, pl. 10. fig. 10. Guéranger says that the species which he now calls *P. Cenomanensis* and which is covered with radiating ribs is the same to which he formerly (Repert. Paléont., etc., 1853, p. 31) applied the name *P. cretaceus*. But in this last named publication he calls *P. Cenomanensis* a smooth species, with very peculiarly folded margins of the aperture, for which reason he thinks that it could form the type of a new genus. The question is this, was the former *P. Cenomanensis* of 1853 only a cast of the present *P. Cenomanensis* of 1867? – in which case its application would be quite correct–, or are they different species? – in which case the name of *P. Cenomanensis* of 1867 would have to be changed. Guéranger does not give any explanation on these points, neither does he mention in his 'Album pal'. the *Pileolus Drueti*, a species with radiating striæ, named in his 'Repertoire' of 1853.

One or two species of *Pileolus* were collected by me some years ago in the cretaceous beds at the 'Traunwand' in the valley of the Gosau (Lower Austria); the specimens are in the mineralogical cabinet of Vienna, and as yet not named or described.

Pictet and Campiche (Mat. p. l. Pal. Suisse, 3me. Ser., pp. 403-404) quote only eleven European species of *Nerita* (including *Neritina*), though their number is considerably larger.

5. *Nerita mammæformis*, d'Orbigny, only known by name.

6. *N. Michaillensis*, P. et Camp.; the dentition of the inner lip has not been observed.

7. *N. turbinata*, Sharpe, probably belongs to the sub-generic type *Neripteron* of *Neritina*, though the involution of the spire is more similar to that in *Alina*.

8. *Neritina bicornis*, Sharpe, is a typical species of *Neripteron*.

9. *Nerita ornatissima*, D'Orb., known only from a short description in the 'Prodrome'; it appears to belong to the type of our *Nerita divaricata* and *Carolina*, to which also the next 16 species have to be referred.

10. *N. Bourgeoisiana*, D'Orb.

11–12. *N. glebosa* and *N. cestophora*, Ryckholt.

13. *N. nodosa*, Geinitz, sp. (*Natica id.*, Geinitz, and *Nat. nodoso-costata*, Reuss).

14. *Nerita Zekeliana*, Stol., olim *Natica rugosa*, Zekeli, and *Natica Römeri*, Reuss; (*vide* Sitz. Akad., Wien, LII, 1865, Revision, etc., p. 48).

15. *N. Hörnesiana*, Zek., sp. (*Natica id.*, Zek.) *vide ibidem.*, p. 49.

16. *N. Orbignyi*, Guéranger, 1867, Album paléont. de la Sarthe, pl. 10, fig. 7.

17. *N. parvula*, Binkhorst, Gast. et. Ceph. craie Limbg., 1861, p. 44, pl. 4, fig. 1.

18. *N. rugosa*, Höninghaus, *ibidem.*, p. 41. This species has been referred to *Otostoma*, d'Archiac, which, as I have already stated, appears to have been founded upon imperfect specimens of *Neritæ*. There is very little doubt that the two next cretaceous species

19-25. *Otostoma Tchihatcheffi* and *ponticum* of d'Archiac, belong to the same group of *Neritæ*. (*Vide* Bull. Soc. Géol., France, XVI, p. 873, etc., and Tchihatcheff's Asie Min., Paléont., 1866, pp. 88-89). I may also quote *Otostoma Archiaci* and *Fourneli* of H. Coquand from Algiers (Geol. and Pal. Prov. Constantine, 1862, p. 180, pl. 4, figs. 10-12). It is not improbable, that the following species, described under different generic names, belong also to the same section of *Nerita*, namely, *Turbo Mundæ*, Sharpe (Quart. Journ. Geol. Soc., Lond., 1850, VI, p. 194, pl. 20, fig. 7); *Nat. Römeri*, Geinitz, (Quadersandsteingebirge, 1849-50, p. 128); *Nat. dichotoma*, Geinitz (Char. p. 48, pl. 13, fig. 5; pl. 18, figs. 14 and 16,* and Kieslingswalda, p. 10, pl. 1, fig. 19), and perhaps some others.

26. *Nerita montis-sancti-Petris*, Binkhorst (Monog. Gast et Ceph. craie de Limbourg, 1861, p. 40), is a spirally striated species, and allied to, if not identical with, the next doubtful

27. (?) *N. costulata*, Römer (Verst. Nord. Kreidegeb., p. 82, pl. 12, fig. 12).

28. *Neritina (Nereis) densata*, Con. (Journ. Acad. Nat. Soc., Phil., IV, 2nd Ser., p. 288, pl. 46, fig. 37). Conrad proposed (loc. cit., p. 289) the sub-generic name *Nereis* (*non idem.* Lin. and others) for this and the recent species *Neritina reclivata*, Say, on account of their having a thick shell and a rounded callous columella. I do not think, however, that their shell is thicker,—so far at least as the recent species is concerned—, than that of typical species of *Neritina*, like *N. Smithii*, *Cumingiana*, *bicolor*, and others; neither does the columella of the recent or the fossil species differ in its *roundness* (?) from that of the other known species.

29. *Nerita deformis*, Gabb (Pal. Calif., 1864, I, p. 137, pl. 21, fig. 96), is based upon a rather imperfect specimen, of which Mr. Gabb says "in fact, except its distorted (naturally?) outline, it has almost no tangible specific character." (!)

30. *Nerita cuneata*, Gabb (ibid. pl. 21, fig. 97) is a fine species of the sub-generic type *Velates*.

31. *N. plebeia*, Reuss., is probably a *Neritina*, belonging to the sub-generic type *Vitta*.

32. *Neritina Cenomanensis*, Guéranger, Album Pal. d. l. Sarthe, 1867, pl. 10, fig. 9 (*Nerita id.*, Guéranger, Repertoire, etc., 1853, p. 31.

33. *N. Goldfussi*, Kefst., is a *Deianira*; it occurs in the Alpine Gosau-deposits.

34-35. *Deianira bicarinata*, Zek. sp. and *D. Hörnesiana*, Stol., are from the same deposits as the last (*vide* Sitzb. Akad., Wien, 1860, Vol. XXXVIII, pp. 488-492; and 1865, Vol. LII, Revision der Gosau-Gastropoden, pp. 49—51).

Doubtful species of *Neritidæ* are *Pileopsis arquata*, Münst. (*Nerita id.* d'Orb.) and *Natica? Retzii*, Nillson, both of which, however, could belong to that family, and with regard to the last

* This figure of a cast showing the absorption of the top-whorls makes it very probable that the species belongs to the family *Neritidæ*.

named species it is very probably the case, because the small number of rapidly increasing whorls, as represented in Nillson's figure, are not often to be met with among *Naticidæ*, but usually occur in the family *Neritidæ*. A doubtful species of *Nerita* was noticed by me from the Gosau-deposits (*vide* Sitzb. Akad., Wien, 1860, Vol. XXXVIII, p. 495).

Prof. Forbes described four species of *Nerita*, which have been variously commented upon by d'Orbigny and subsequent authors, though not with great success. We have been able to procure good specimens of all of our species of the *Neritidæ*, and after having compared Prof. Forbes' originals in the London Geol. Society's collection, we have to report from the South Indian cretaceous deposits five species, which will be described subsequently;

36. *Neritina compacta*, Forbes, sp.=*Nerita id.* Forbes.
37. „ *decipiens*, nov. sp.
38. *Nerita divaricata*, d'Orb. = *N. ornata*, Forbes.
39. „ *Carolina*, nov. sp.
40. „ *rugosissima*, Forbes, sp. = *Natica? idem*, Forbes.

Nerita munita of Forbes is a *Vanikoro* (vide p. 309), and *Nerita oviformis*, Forbes, is a species of *Euptycha* of the family *Actæonidæ*, of the Opisthobranchia.

Thus we have at present 40 recorded species of *Neritidæ* from cretaceous rocks, and most of these species are from the upper or Senonien beds. Still it can hardly be supposed that they represent more than a limited number of those species which existed during that period. But the fact that among this comparatively small number of already known cretaceous species, nearly all the generic and sub-generic types—(except *Navicella*)—of the recent *Neritidæ* are represented, seems to prove that these divisions have a better classificatory value, than they would appear to possess from a general review of only the living species.

LXXVII. NERITINA, *Lamarck*, 1809.

1. Neritina compacta, *Forbes, sp.* Pl. XXIII, Fig. 8, and Pl. XXVIII, Fig. 4.

1846. *Nerita compacta*, Forbes, Trans. Geol. Soc. Lond., VII, p. 122, Pl. XV, Fig. 6.
idem. d'Orbigny, Pictet and Campiche, Gabb, and others.

Nerit. testa subglobosa, transversaliter subovata, levigata, striis incrementi subobsoletis notata; anfractibus tribus; spira brevi, acuminata, sæpe obtuse decollata; apertura semilunata, postice angustata, labio calloso, levi, margine interiori prope recto, tridentato; dente posteriori crasso, dentibus duobus anterioribus minutis.

This species appears to be a true *Neritina*, having the spire short and pointed and in form resembling several recent species. The inner lip has on the margin only three teeth, of which the posterior one is the strongest and the two anterior much smaller, while in the typical recent *Neritinæ*, there are usually a large number of small teeth present. The surface of the shell only shows fine striæ of growth. I have not been able to observe the spiral striation to which Prof. Forbes alludes, either on his original or on two other specimens in our Survey collection.

Locality.—Near Garudamungalum in calcareous, bluish sandstone, and near Veraghoor, in soft, whitish sandstone; rare.

Formation.—Trichinopoly – and Arrialoor – groups.

2. Neritina (Velates) decipiens, *Stoliczka*, Pl. XXIII, Figs. 9-10.

Nerit. testa transversaliter rotundate-ovata, depressa, levigata, striis incrementi minutis notata; anfractibus duobus; spira plana, fere obtecta; ultimo anfractu margine exteriore late expanso, labio calloso, convexo, levi, margine interiori æqualiter crasse dentato.

A much depressed, transversally broadly ovate shell with smooth surface and indistinct, flattened spire. There are generally not more than two whorls present, and the spire is sometimes perfectly enveloped. The outer margin of the aperture is largely expanded, anteriorly on the internal side slightly thickened and smooth. The inner lip is formed by a strong, convex and roundish callosity, which has on the internal margin eight equally strong teeth.

Comparing with our shell young specimens of *Velates Schmideliana* (see Deshayes' Anim. s. vert. Foss. Paris, edit. I, pt. II, pl. 18, figs. 1-2), it will be seen that the cretaceous species very probably belongs to the same sub-generic division of *Nerita*. This is indicated not only by the envelopment of the spire, the great expansion of the outer lip and its flattened margins, but principally by the peculiar form of the callose inner lip and its strong and equal dentition, which is perfectly distinct from that of any recent *Neritinæ*. Our specimens – 10 in number and the largest not above 15mm. in transversal diameter—may be all young shells.

Locality.—Comarapolliam, in light coloured siliceous sandstone; not very rare.

Formation.—Arrialoor group.

LXXVIII. NERITA, *Adanson*, 1757.

1. Nerita divaricata, *d'Orbigny*, Pl. XXIII, Figs. 11–12, and Pl. XXVIII, Fig. 5.

1846. *Nerita ornata*, Forbes, Tran. Geol. Soc., Lond., VII, p. 121, Pl. XIII, Fig. 5 (non *idem* Sow., Melv.).
1847. „ *divaricata*, d'Orbigny, Paléont. Voy. Astrolabe, Pl. IV, Figs. 43-44.

Nerit. testa transversaliter sub-ovata, sub-globosa, crassa, anfractibus tribus composita; spira brevi, aliquantisper vix elevata; superficie costulis numerosis transversalibus atque antice in ultimo anfractu striis spiralibus decussantibus notata, costulis atque striis in speciminibus adultis sæpe obliteratis; apertura semilunari, angusta, intus valde callosa; margine labii octo dentibus crassis instructo, prope recto.

Transversal diameter of largest specimens about 40 mm.

This fine species has the same transversally oval shape as the *N. Zekeliana* from the Alpine Gosau-deposits, but it can be distinguished from it by the transverse ribs being somewhat thinner and more numerous. I have already mentioned that there have been from Europe and Africa a large number of very similar forms described under different names, but they may all prove to belong only to one and the same species. Well preserved specimens must, however, be examined before a reliable opinion as to their identity can be given.

Our present species consists of about three rapidly increasing volutions, the spire being more or less distinct in various specimens. The anterior half of the last

whorl is ornamented with spiral striæ, which in crossing the transverse ribbings produce an indistinct granulation. Very fine transverse striæ of growth can be traced between the ribs on well preserved shells. Large and fully grown specimens have the spire usually more enveloped by the last volution and are almost smooth, the ornamentation of the surface having nearly all disappeared, or become obliterated. In some specimens there is a slight depression to be observed along the suture of the last whorl. The aperture is internally very much thickened; the outer lip being smooth and sharpened from within, the inner lip flattened, smooth with about eight sub-equal teeth on the edge, which is almost straight.

It is probable that the *Otostoma ponticum*, d'Archiac (Bull. Soc. Géol. France, 1859, XVI, p. 874, pl. 19, figs. 2-3), is identical with our Indian species, for its ornamentation does not appear to differ at all.

Locality.—S. E. of Parchairy, in greyish calcareous sandstone; not rare.

Formation.—Arrialoor group, very near the boundary of the Trichinopoly group.

2. Nerita Carolina, *Stoliczka*, Pl. XXIII, Figs. 13-14.

Nerit. testa transversaliter rotundate-ovata, sub-depressa, anfractibus duobus seu tribus, postice depressis composita, spira subplana; superficie ultimi anfractus transversaliter crasse-costata atque minute-striata; costis ad medium gibbosis, subtuberculatis, antice sub-obsoletis atque duabus liris crassis intersectis; apertura lata, labro expanso atque acuto, labio calloso, valde declivi, levi, in margine sub-æqualiter dentato, dentibus circiter octo.

Transversal diameter of largest specimen 30 mm.

Shell transversally roundish oval, depressed, composed of two or three very rapidly increasing volutions, with a flattened or very slightly elevated spire. The last whorl is ornamented with strong transverse ribs, which form rounded tuberculations about the middle; on the anterior half of the whorl they are almost obsolete and replaced by two strong spiral ridges, one of which forms the anterior edge of the shell. Fine striæ of growth are distinctly traceable throughout the entire surface. The aperture is very much enlarged, the outer lip being widely expanded, thickened and smooth internally, but sharp on the edge. The inner lip is formed by a large flattened and smooth callosity, extending very low down in the aperture, and provided on the internal edge with about eight nearly equally strong teeth.

The peculiar ornamentation of our species resembles that of the *Ner. Hörnesiana*, Zek., sp., from the Gosau-deposits, and is distinguished from it merely by the two strong anterior ridges, while in that last named species there are on the anterior portion of the last whorl several thinner and sub-tuberculated ridges. The only two other known cretaceous species of the same type are *Ner. nodosa*, Gein., sp. (*Nat. nodoso-costata*, Reuss) and *Ner. cestophora*, Ryckholt.

Locality.—Seraganoor, in conglomeratic sandstone; rare.

Formation.—Arrialoor group.

3. Nerita rugosissima, *Forbes*, sp. Pl. XXV, Fig. 6.

1846. *Natica rugosissima*, Forbes, Trans. Geol. Soc., Lond., VII., p. 137, Pl. XIV, Fig. 7.
idem, d'Orbigny, Pictet, Gabb, and others.

Ner. testa sub-rotundata, sub-globosa; anfractibus tribus, postice prope suturam canaliculatim depressis composita, spira vix elevata; ultimo anfractu convexo, transversaliter costulis numerosis crispatis, sub-acutis ornata, costulis in parte anteriori sulcis angustis, decussantibus interruptis; apertura dilatata, labio angusto, declivi, postice incrassato, antice insinuato, intus in margine multi-dentato.

A small sub-globose shell, consisting of three volutions, which are posteriorly somewhat depressed. The spire is very slightly prominent; the last whorl convex, ornamented with numerous sharp, undulating ribs, which are on the anterior portion interrupted by narrow sulcations. The form of the inner lip is very peculiar; it is narrow, precipitous, posteriorly much thickened and anteriorly widely insinuated; the inner edge is provided with six rather fine teeth on the insinuated portion, the posterior one not being clearly traceable.

This peculiar species was first described by Prof. Forbes as a *Natica*, but the form of the inner lip places its present generic determination beyond any doubt; the sharp undulating ribs distinguish the species from any other known *Nerita*.

Locality.—The only figured specimen was found in a light coloured calcareous sandstone S. E. of Parchairy; Prof. Forbes quotes it from Verdachellum.

Formation.—Arrialoor group.

II. *Tribe*, Ciliipedata.*

We place in this tribe all the different genera of shells, which are usually described in the family *Trochidæ* or *Trochacea*. The animals are true Prosobranchia Scutibranchiata, that is, they have only one branchial plume, consisting of two series of lamellæ, which are placed on either side of a thin membrane. The principal characteristic of the animals lies in the presence of a lateral fringe, which generally originates at the external side of the eye-pedicles, and continues laterally for some distance on the upper part of the foot, on either side. The filaments on the fringe are sometimes short, numerous, and all of equal size, as for instance, in the *Stomatiidæ*, but generally there are three or four pairs of them much longer, as in most of the species belonging to the other families. The tentacles are usually thin and long. The head is provided with a short and thick rostrum, which is sometimes retractile. The teeth of the radula are distinguished by a large number of equally formed laterals, an arrangement common to many families which are classed by Troschel, Lovén, partially by Gray and others, in the sub-order Rhipidoglossa. Comparing the general structure of the teeth of the Ciliipedata with those of the Planilabiata it may be observed, that the former have the central teeth generally sub-equal and the laterals tolerably thick, while the latter have the central teeth rather unequal and the laterals very thin.

* With reference to the presence of a ciliated *fringe* on the *foot*.

The shell is *spiral, turbinate or depressed, and generally pearly within.* The operculum is spiral, horny, or to a larger or smaller extent calcareous.

The CILIIPEDATA contain such a large number of different shells, that it appears most desirable to divide them into several families. Many conchologists object to these family-divisions on the ground that the characters of distinctions are not equal in importance to those upon which other families of Gastropoda are generally formed. It seems to me, however, that these objections are more due to the want of our present knowledge of the animals, than to any real identity in organisation. The distinctions of the *TROCHIDÆ* and *TURBINIDÆ* are certainly not very important, still they are remarkably constant. The animals of the *LIOTIIDÆ* are as yet very little known. The less pearly internal structure of the shell and the peculiarly formed operculum makes it very probable that some remarkable distinctions exist in the animals. The little reliable information which we have of the animal of *Umbonium* seems to show that the family *UMBONIIDÆ* (*ROTELLIDÆ*) is fully entitled to that distinction. We shall in our divisions of the families principally follow the classification of Dr. Gray, in his Guide of 1857.

In geological history the CILIIPEDATA belong to the number of the oldest known Gastropoda, for they appear to be represented even in the lower Silurian rocks. It is true that some of them have a form common to many *LITTORINIDÆ* or *SOLARIIDÆ*, and thus can very easily be mistaken for genera belonging to those families; still there are many others of such characteristic and typical forms as leave little doubt regarding their correct determination. During the secondary epoch the species of the CILIIPEDATA increase very largely in number, and many genera are met with which are at the present time still to be found in tropical seas, though very rarely. The tertiary deposits are equally rich as regards number of species, but these, as likewise those of the secondary epoch, generally are of small size, while the recent fauna is characterized by very many species of large size. As to the number of generic types the present fauna may be considered the richest, though a large number of the genera were already represented in former periods. Still many additions can justly be expected, when dredging operations have been extended to the different tropical seas, for there are found exactly those minute forms which are so common in a fossil state, and of which so many new generic varieties have been added to our knowledge during the last few years. Almost every conchological excursion may be said to furnish quite new materials in this tribe of Gastropoda.

As a rule, the larger number of the CILIIPEDATA are littoral inhabitants, feeding on sea weeds; they are also common on coral reefs, and are much more numerous in the eastern than in the western seas. We accept here the following families,—

L.—*UMBONIIDÆ*,
LI.—*LIOTIIDÆ*,
LII.—*TURBINIDÆ*, *(Sub-fam. PHASIANELLINÆ, TURBININÆ,* and *ASTRALIINÆ)*,
LIII.—*TROCHIDÆ*, *(Sub-fam. GIBBULINÆ, TROCHINÆ, MARGARITINÆ* and *DELPHINULINÆ)*,
LIV.—*STOMATIIDÆ*,

the last of which forms a passage to the *HALIOTIDÆ*.

L. *Family,—UMBONIIDÆ.*

UMBONIINÆ, H. and A. Adams, Gen. I, p. 407; *ROTELLADÆ*, Gray, Guide, 1857, p. 139; *ROTELLINÆ*, Chenu, Man. I, p. 353; *Globulus*, Schum., in Philippi's Handbuch der Conch., 1853, p. 208; *UMBONIIDÆ*, A. Adams, Ann. mag. nat. hist., 1863, XI, p. 264.

The animals of the *UMBONIIDÆ* are as yet very insufficiently known. The only reliable description is said to be that of *Um. vestiarium*, (var. *lineolata)* Linné, by Gray, in the Ann. mag. nat. hist., II. Ser., vol. XII, and Guide, 1857, p. 140. Taking the organisation of this species as the type, the animals of the *UMBONIIDÆ* are distinguished, from those of all other CILIIPEDATA, by having a very short, retractile proboscis which is surrounded by a veil. The radula is linear, long; the teeth in general formed very similarly to those of the other CILIIPEDATA, except that the central ones are less denticulated. Tentacles are two, linear; right free, simple, with a compressed lobe on its inner side; left tentacles with a large membranaceous expansion folded over the mouth, and then back to the side of the head, continued by a slight ridge to the lateral fringe. Lateral fringe distinct, with three tentacles on each side, produced on the front of the right side into a large, oblong, fleshy lobe, which probably covers the base of the shell and forms the callosity of the axis (Gray, Guide 1857, p. 139). If the basal callosity be formed by the peculiar fleshy expansion of one portion of the fringe, the unequal development of the latter may in general be considered as a good character, because there is always some sort of a callous ridge to be observed even in the sub-umbilicated genera belonging to this family.

The shells of the *UMBONIIDÆ* are mostly *orbicular, with a short spire; aperture roundish with the outer lip sharp or slightly thickened; columella thick, generally passing into a callous covering at the centre of the base; surface polished, without epidermis; internal layer of the shell pearly.* Operculum horny, multispiral.*

The *UMBONIIDÆ* never seem to have been very numerous. Fossil species occur from the palæozoic deposits upwards, but they are always scarce, though a good number of them appears to have been described under the names of *Trochus, Turbo, Delphinula* and others. The jurassic deposits are richer than the cretaceous, in specific as well as in generic forms. Up to the date of the last edition of Deshayes' 'Anim. s. vert., foss. de Paris,' remarkably few species were known from the tertiary strata, and of those which have been reported very few appear to belong to *Umbonium (Rotella)* proper. The recent species are sparingly distributed in all tropical seas; they burrow in the sand, and their shells are consequently deprived of an epidermis. The *Umbonium vestiarium* is found in the Bay of Bengal on sandy parts of the shore, where except the *Cytherea casta, Tympanotomus (Cerithium) alatus*, Philippi, a few species of *Purpura* and *Hemifusus*, hardly any other living shells are met with, though Foraminifera are very numerous.

* The operculum of our Bengal variety of *Umb. vestiarium* is thin, transparent, horny, externally concave, internally pyramidally elevated, consisting of very numerous narrow volutions; the margin is very thin, but not ciliated.

The following genera have been distinguished in this family:—

1. *Umbonium*, Link, 1807 (*Helicina*, Lamck, 1801, *ex parte*; *Pitonillus*, Mont., 1810; *Globulus*, Schum., 1817, *Rotella*, Lamck., 1822).

Shell orbicular, depressed, polished; columella thick, smooth; basis covered with a large, margined callosity; outer lip thin, sharp on the edge.

Lamarck did not at first distinguish the true *Helicinæ* from the shells for which Link in his Catalogue proposed the name *Umbonium*. There cannot be any doubt as to the identity of Montfort's *Pitonillus* and Schumacher's *Globulus* with *Umbonium*, but the name *Ptychomphalus* of Agassiz appears to have been applied to different shells, which we shall again notice in the family PLEUROTOMARIIDÆ.

H. and A. Adams' sub-generic distinction *Ethalia* does not appear to be well founded. A. Adams (Ann. mag. nat. hist., 1861, VIII, p. 308) treats *Ethalia* as a separate genus, but he also refers to it species like *Eth. atomaria*, which have the umbilical region perfectly covered by a callus. It seems to me, that the little species subsequently referred by A. Adams and Carpenter to this sub-generic division are generically not different from *Teinostoma*. From descriptions of other species, like *Eth. omphalotropis*, Adams (Ann. mag. 1863, XI, p. 266), it would appear that the principal distinction of *Ethalia* from *Umbonium* is the presence of an umbilicus, which is surrounded by a keel. If this were the real distinctive character of *Ethalia* there would be far more reason to separate it generically from *Umbonium*. The fossil species, like *Trochus Moreanus*, d'Orb. (Pal. franç. terr. jur. II, pl. 320, figs. 1-4) from the Coral-rag, and others, must then be referred to *Ethalia*.

2. *Photinula*, H. and A. Adams, 1854 (Gen. I, p. 427—*Photina*, H. and A. Adams apud Gray, Guide, 1857, p. 141). *Shell like Umbonium, smooth and polished, but usually spirally lineated; the umbilical callus is impressed.* This genus includes recent and fossil shells.

3. *Lewisiella*, Stoliczka, 1868. *Shell subconical, smooth or spirally striated, aperture roundish, margins continuous, columella solid, in the centre of the basis with a broad callosity, the edge of which is in front spirally twisted and joins the anterior portion of the inner lip by a conspicuous thickening.*

I consider the single, as yet known, liassic species *Pitonillus conicus*, d'Orb., as the type of the genus. Chenu (Man. I, p. 354) apparently attempts to reserve Montfort's name *Pitonillus** for the fossil species of the UMBONIIDÆ, and Lamarck's name *Rotella* for the recent ones. This is, however, inadmissible, because Montfort's name was unquestionably applied to the same generic type, for which Lamarck subsequently proposed the name *Rotella*. Besides d'Orbigny's figure of *P. conicus* which Chenu copied is, as I have shown in my monograph of the liassic fossils of the Alpine Hierlatz strata (Sitz. Akad., Wien, 1861, Vol. XLIII, p. 178, pl. 3, fig. 4), not correct in the most important point. The callosity does not cover the basis flatly as in the recent species of *Umbonium*; it is moreover raised, having a sharpened twisted edge in front, and joining the inner lip at its

* The name *Pitonellus* is evidently only a misprint.

anterior termination. The aperture also is not sub-quadrangular, as shown in d'Orbigny's figure, but round. The total separation of the aperture from the cavity, which is formed by the raised edge of the callosity on one, and by the inner lip on the other side, distinguishes this genus readily from *Camitia* of Gray. I do not know any other genus which, as regards this peculiar form of the umbilical callus, could be better compared with *Lewisiella*, than *Lewisia* which has been proposed by Mr. Chitty for a number of species of *Stoatostoma*, like *St. Philippianum*. The edge of the callus is only so far different, as it is not thickened on the anterior end of the inner lip, though on the whole more prominent in front. The genus *Cynisca*, H. and A. Adams, (Ann. mag. nat. hist., 1864, VIII, p. 243) has a similar, spirally twisted callous edge, but these shells are spirally ribbed and the outer lip externally thickened (vide fam., *Liotiidæ*). *Teinostoma umbilicare*, Desh. (Anim. s. vert., foss. de Paris, 2me. ed. Vol. II, pl. 63, figs. 27-29) may possibly be a *Lewisiella*.

4. *Camitia*, Gray, 1840 (H. and A. Adams' Gen. I, p. 409). *Shell depressed like Umbonium, but the columellar callosity has a twisted edge in front, which terminates with a tooth in the aperture, with which the cavity of the callus communicates.*

We do not know any fossil species belonging to this genus.

5. *Chrysostoma*, Swainson, 1840 (H. and A. Adams' Gen. I, p. 410). *Shell sub-turbinate, solid, smooth, inner lip thickened, the end of the columella covering wholly or partially the umbilical region, but not expanding over the same, outer lip obtuse, not enlarged.* There is only one recent species, *Ch. paradoxum*, known from the eastern seas, but in a fossil state the genus has a large number of representatives, especially in the triassic and jurassic deposits.

The *Teinostoma Wateleti*, Desh. (Paris foss. 2me ed., Vol. II, pl. 63, figs. 37-39) from the Paris basin is more probably a *Chrysostoma* than a *Teinostoma*.

6. *Teinostoma*, H. and A. Adams (Gen., I, p. 122, and II, p. 615). *Shell orbicular, polished; columella terminating with a more or less expanded callus; aperture with the margins obtuse and usually somewhat enlarged or produced at the periphery.* The *Teinostomata* are generally shells of small size, white, polished and subvitreous. They appear to be very numerous on sandy coasts of tropical seas, and are distinguished from the true *Umbonia* by their usually enlarged aperture, with its obtuse or somewhat thickened margins. A. Adams has described, since the publication of the "Genera," many new species from the eastern seas (*vide* Ann. mag. nat. hist., 1863, XI, p. 267, etc.). I have already mentioned, that some of the species, described by the same author under the name *Ethalia*, very probably belong to *Teinostoma*.

In a fossil state these little shells have been as yet only insufficiently observed, though there can be little doubt, that farther researches will increase their number very considerably.* A few species are described by different authors

* Hörnes does not describe a single species from the Vienna basin, but since the publication of his valuable work, in more extended washings of sand and clay, searching for Foraminifera, Bryozoa, &c., several of these little shells have been found.

under the names of *Trochus*, *Delphinula*, *Rotella* and others. Deshayes in his last edition of the Paris fossils (Vol. II, p. 919) reports the unusually large number of 14 species, though a few of them appear to belong to *Chrysostoma* and *Lewisiella* (n. gen.) It seems very improbable, that the few among Deshayes' species, which have a small umbilicus and a less developed callus, can be generically separated from *Teinostoma* (as may be supposed from the inspection of the figures) unless they belong to *Vitrinella*. If they are not fully grown shells, they may belong either to *Teinostoma*, to *Adeorbis*, or *Vitrinella*. A. Adams (Ann. mag., 1861, VIII, p. 305) describes from Japan a *Teinost. Carpenteri*, of which he says, that it possesses a slight rimal fissure. The secondary species of *Teinostoma* are still less numerous, as the difficulty in procuring them is generally much greater. We notice the only one known from cretaceous rocks, *Teinost. cretaceum*, d'Orb. sp.. Jurassic species are noticed by Quenstedt (Jura), d'Orbigny (Pal. franç.), Buvignier (Stat. de la Meuse, etc.), and others. The *Rotella macrostoma* described by me from the Lias (Sitz. Akad., Wien, 1861, XLIII, p. 178, pl. 3, fig. 5) must be considered as a *Teinostoma*, though of a somewhat larger size.

7. *Helicocryptus*, d'Orbigny, 1850, (Pal. franç. terr. jur., II, p. 302); *planorboid, rather involute, smooth or slightly ornamented shells, which have the columellar lip callous, so as to fill up the internal space between the outer lip and the sides of the preceding whorl, which projects in the space of the aperture; the outer lip is sharp, not expanded or very perceptibly thickened; the umbilical region is without callus.*

The typical species is *H. pusillus*, d'Orbigny, l. cit. pl. 321, figs. 1-4, from the corallien of St. Michel. Another jurassic and very similar species from the same locality was described by Buvignier as *Rotella dubia*, (Stat. Géol. de. la Meuse, 1852, p. 36, pl. 24, figs. 6-9). A few more are known from cretaceous deposits, but none have been reported from the tertiary rocks. The recent forms which are allied to the fossil *Helicocryptus*, are some of the involute species of *Vitrinella* and *Teinostoma*.

? 8. *Vitrinella*, C. B. Adams, 1850 (H. and A. Adams, Gen., I, p. 434), *small, pellucid, trochiform or orbicular shells, which have a vitreous structure. The umbilicus is either narrowly open or internally filled with a callus, so as to leave a depression in the centre of the basis.*

The species are found in sand under similar circumstances as the *Umbonia* and *Teinostomata*, to which they are closely allied. I should think the non-umbilicated species can hardly be distinguished from *Teinostoma*, though I do not know any of the typical Jamaican species from personal examination.

The *Teinost. umbilicare*, Desh. (Paris foss, 2me ed., II, pl. 63, figs. 27-29) may be a *Vitrinella* or a young *Teinostoma*. Other fossil species, which may belong to that genus, are scarcely known. Adams in a paper on *Adeorbis* (Ann. mag. nat. hist., 1861, VIII, p. 244) says, that "the genus *Vitrinella* is composed of a somewhat incongruous assemblage," etc. It would not be very surprising to find, that the umbilicated species of *Vitrinella* belong to *Adeorbis* or *Mörchia*, and the non-umbilicated to *Teinostoma;* what would then remain to be called *Vitrinella* has

to be proved. Nor do I think it very probable, that most of those little shells, for which Fischer proposed the name *Pseudorotella*, are very different from *Teinostoma* and other similar forms. Fischer's characteristic (Journ. d. Conch., 1857, VI, p. 52) of *Pseudorotella* runs as follows: *shell thin, transparent, globose or flattened; whorls few, finely striated; umbilicus covered with a transparent callus; shining; peristome not continuous; outer lip arcuated, simple, sharp.* The typical species is *Pseudor. semistriata*, D'Orb.

We here retain the genus for the umbilicated species only. *Teinost. Grignonense*, Desh. (Paris fossils, 2nd edit., pl. 63, figs. 30–32) is in this sense to be considered as a *Vitrinella*. The only cretaceous species which we know is from the Verdachellum deposits at Pondicherry, *Vitrinella orbiculata*, n. sp.

? 9. *Umbonella*, A. Adams, 1863 (Ann. mag. nat. hist., XI, p. 265); *shell globose subconic, solid, porcellanous, polished, with a narrow umbilicus; aperture subquadrate, inner lip anteriorly expanded, margin of the umbilicus crenulated.*

A. Adams considers the *Turbo murreus* (Reeve, Conch. Icon. Monog. *Turbo*, species 54, pl. 12,) as the type of the genus. This species does not appear to differ generically from *Margarita*, unless its sole character is placed in the smooth and polished surface, on which account, I presume, it has been referred by A. Adams to the family *Umboniidæ*.

10. *Isanda*, H. and A. Adams, 1854 (Gen. I, p. 409); *shell subconic, smooth, porcellanous; aperture subquadrate, inner lip straight, margin of umbilicus crenulated, outer lip thin.*

There are a few tertiary species known, which may belong to this genus, but I do not know any from secondary or older deposits.

11. *Calceolina*, A. Adams, 1863 (Ann. mag. nat. hist., XI, p. 267), founded upon *Neritina pusilla* of C. B. Adams. *The shell is characterised by its depressed and oblong form, short spire, rapidly increasing whorls, and the umbilicus covered by a callus.* The aperture is semicircular, not pearly within; the inner lip is covered by a large callus, which spreads over the umbilicus, the anterior margin of the aperture being almost straight.

There are several similar little shells to be found in the eastern seas; they very much resemble *Neritinæ* in general form, but have the inner lip somewhat produced in the middle without any teeth on the edge of the same. The surface is smooth and polished. A. Adams does not describe the form of the inner lip of the so-called *Calceolina* sufficiently, to enable his shell to be identified with accuracy.

12 ? *Microthyca*, A. Adams, 1863 (Ann. mag. nat. hist., XI, p. 265), has been proposed for a subturbinate species, *M. crenellifera*, the shell of which is *subporcellanous, spirally ribbed; aperture semicircular, with continuous margins, both being thickened and the umbilicus crenulated.* The position of this genus in the *Umboniidæ* appears to me rather doubtful; it seems almost quite as probable that it belongs to the *Liotiidæ*.

13. *Crossostoma*, Morris and Lycett, 1850 (Moll. Great Oolite, pt. I, p. 72); *shell subturbinate, smooth; aperture round, with the margins united, externally thickened and expanded; umbilicus entirely covered with callus.*

The peculiar expansion of the margins* and the circular aperture must be considered as the distinctive characters of this genus, in which only species, like *Cross. Prattii*, Morris and Lycett, or *Cross. (Delphinula) reflexilabrum*, d'Orb., can be admitted. The two other species, *Cr. ? discoideum* and *Cr. ? heliciforme*, doubtfully placed by Morris and Lycett in this genus, are either not fully grown *Crossostomata*, in which case their specific determination must remain doubtful; or they are full grown shells, in which case they must be transferred to *Chrysostoma*.

No cretaceous, tertiary, or recent species of true *Crossostoma* are as yet known.

14. *Pterocheilos*, Moore, 1867 (Quart. Journ. Geol. Soc., Lond., XXIII, p. 549, pl. 14, figs. 4-5); (not *Pterochilus*, Klug, Hooker, Alder and Hancock, and others). This genus was lately proposed for a species, *Pt. primus*, from the liassic conglomerate of Brocastle. The shell is stated to be very thick, small, with the general contour angulated or rhomboidal, smooth; spire short, etc.; last whorl centrally carinated, the carina terminating in a wing-like boss or projection on the outer lip; aperture with a thick, circular peristome, columella thick, folded, sub-umbilicated, greatly extending beyond the peristome, and possessing a wide but shallow sulcus towards its base. This genus appears to be related to the species of *Crossostoma;* it can hardly be classed in any other family.

The following are the only species of the *Umboniidæ*, which have as yet been reported from cretaceous rocks, though, as I have already stated, several others of the small, smooth species of *Trochus, Turbo* and *Straparolus* (or *Euomphalus*) may be shown to belong to *Umbonella, Vitrinella, Microthyca*, and other allied genera.

1. *Rotella Archiaciana*, d'Orb., 1842 (Pal. franç. terr. crét. t. II, p. 192, pl. 178, figs. 4-6) has more the appearance of *Photinula*, than of a true *Umbonium*.

2. *Rotella Michoni*, Coquand, 1859 (Bull. Soc. Géol. France, t. XVI, p. 956) may be also a *Photinula*, inasmuch as it is marked with spiral and transverse striæ.

3. *Rotella cretacea*, d'Orbigny, 1847, is our *Teinostoma id.*

? 4. *Pitonellus tuberculatus*, Guéranger, 1853 (Essai d'un Report. Pal. de la Sarthe, etc., p. 31). M. Guéranger does not mention this species in his recent "Album pal., etc., 1867," but he gives two figures of the *Delphinula tuberculata*. Can one of the specimens have been formerly mistaken for a *Pitonellus?*

5. *Planorbis radiatus*, Sow., 1818, Min. Conch. II, pl. 140, fig. 5, is a true *Helicocryptus*, to which it has been already referred by d'Orbigny (Prod. II, p. 151). This species was also found by Guéranger in the Department de la Sarthe (Album paléont., etc., 1867, pl. 10, fig. 23).

6. *Helicocryptus ornatus*, Guéranger, 1855, (Essai Pal. Sarthe, etc., p. 31, and Album pal. 1867, pl. 10, fig. 22) is very similar in form, but larger and ornamented with spiral striæ.

7. *Vitrinella orbiculata*, n. sp.

* Similar to the *(Platystoma) Suessi*, Hörnes, from the Alpine Trias.

LXXIX. TEINOSTOMA, *H. and A. Adams*, 1853.

1. Teinostoma cretaceum, *d'Orbigny*, sp. Pl. XXV, Fig. 7.

1847. *Rotella cretacea*, d'Orbigny, Voy. Astrolabe, Paléont, Pl. IV, Figs. 18-21.
1850. *Pitonellus cretaceus*, d'Orbigny, Prod. II, p. 223.

Teinost. testa orbiculari, minima, levigata, polita; spira brevissima; ultimo anfractu ad peripheriam rotundate angulato; basi convexa, callositate tenui tecta; apertura obliqua, sub-quadrangulari, paulo dilatata; labro ad marginem obtuso.

The single specimen, which we have procured, has a diameter of only about 2 millimetres; it is quite smooth and polished, with a very short spire and a uniformly convex basis. The last whorl is somewhat irregularly coiled, slightly angular on the periphery, and there is no trace of an umbilicus perceptible. The aperture is sub-quadrangular, with the outer margin obtuse, and the inner slightly callous. The specimen obtained by d'Orbigny from (?) Pondicherry was a little larger than ours, but otherwise not different.

Locality.—Comarapolliam, in soft, yellowish sandstone; very rare.

Formation.—Arrialoor group.

LXXX. VITRINELLA, *Adams*, 1850.

1. Vitrinella orbiculata, *Stoliczka*, Pl. XXVIII, Fig. 16.

Vitrin. testa orbiculata, tenui, vitrea, anfractibus tribus, rapide crescentibus, sutura impressa sejunctis composita, spira depressa; ultimo anfractu ad peripheriam rotundato; basi late umbilicata, haud callosa; superficie striis incrementi minutissimis notata; apertura transversaliter ovata, marginibus tenuissimis; labro ad basin late insinuato.

Height : transverse diameter of the shell (consd. as 1·00) ... 0·53.

The orbicular form of the extremely thin and transparent shell, being smooth and largely umbilicated and having the outer lip on the base widely insinuated, are characters which agree with typical species of recent *Vitrinellæ*, from which the present one only differs by its somewhat larger size. The small number of whorls, their rapid increase and the deep suture, are important specific distinctions.

Locality.—Verdachellum, in a brownish calcareous sandstone; very rare.

Formation.—Verdachellum group.

LI. *Family,—LIOTIIDÆ.*

Liotiinæ, H. and A. Adams, Gen. I, p. 403; Chenu, Man. I, p. 351; *Liotiadæ*, Gray, Guide, 1857, p. 146.

The animal of *Liotia* is said only to differ from that of *Turbo* by the absence of lobes between the tentacles, but appendages are present on the outer side of these; median head-lobes are, however, known in *Cyclostrema*, the animal of which rather

resembles that of *Scissurella (Anatomus)*; the body is cylindrical, the tentacles either thick and short, or thin and prolonged; foot small with short appendages, head produced, eyes on conspicuously thickened bulgings.

The shells of the *Liotiidæ* are usually of small size, sub-orbicular, with short spire, transversally and spirally ribbed, often umbilicated, with the aperture circular, having more or less thickened and continuous margins; internally with a very thin pearly layer, which is said to be occasionally wanting. The operculum is horny inside, calcareous externally, many whorled, in most of the recent species consisting of separate, shelly particles, which are arranged in numerous, spiral lines.

The *Liotiidæ* possess several characters by which they appear to connect the *Umboniidæ* with the *Turbinidæ*, inasmuch as many of the species are equally related to both of these; the opercula have the shape of the former and, partially, the structure of the next family; the peculiarly thickened margins of the aperture and the thickness or want of a distinctly pearly internal layer of the shell, all seem to indicate an independent position of this family, intermediate between the two.

The principal genera referred to it are according to A. Adams,—*Mörchia*, Adams; *Adeorbis*, Wood; *Cyclostrema*, Marryatt, with the sub-genera *Daronia*, *Cynisca* and *Tubiola*;* *Liotia*, Gray, with the sub-genera *Ilaira*, H. and A. Adams, and *Arene*, H. and A. Adams, the species of the latter being, however, in no way different from other *Liotiæ*. *Minolia* has been proposed (Ann. mag. nat. hist., 1860, II., p. 336) by A. Adams for a *Torinia*-like shell, being, however, pearly within, with the aperture circular and the margins united. *Haplocochlias*, Carpenter, 1864 (*ibid.* vol. XIII., p. 476), has a similar but internally non-pearly shell, the columella is thin and the outer lip varicose.

It is rather doubtful whether all these genera and sub-genera can remain in this family. I have already remarked that *Adeorbis* has, on the authority of Deshayes, been placed in the *Rissoidæ*, (see p. 273). The animal of *Cyclostrema* appears to be more allied to that of *Scissurella*, than to any *Trochidæ* or allied families. *Mörchia* is also doubtfully placed here, because it seems more closely allied to the *Rotellidæ*. The sub-genus *Tubiola* is the same as Montfort's *Lippistes*, the type being *Turbo niveus* of Chemnitz; this species may be an *Adeorbis*, if the shell be not pearly. With regard to *Ilaira*, the type of which is *Delph. evoluta*, Reeve, it also remains to be ascertained whether the shell is pearly within or not. If it be not pearly it ought most probably to be referred to *Discohelix* of the *Solariidæ*.

The recent species are with few exceptions not common shells, and this chiefly accounts for our imperfect knowledge of them; in most cases the animals and the opercula remain to be discovered.

There is a large number of shells known which appear to represent this family in former geological periods. Several characteristic species of *Liotia* occur even in the lowest secondary deposits. From cretaceous beds I may mention *Delphinula Dupiniana*, d'Orb., *Turbo dispar*, d'Orb., *Straparolus Michaillensis*, Pictet et Camp.,

* Sowerby's Thesaurus, pl. 255 and 256.

Turbo Michaillensis, Pict. and C., *Turbo Loclensis*, P. and C., *Delphinula Bonnardi*, d'Arch., *Turbo Geslini* and *Mulleti*, d'Arch., and probably others which are only known from specimens too imperfect to admit of even an approximately correct generic determination.

The multispiral, calcareous opercula figured by d'Orbigny (Pal. franç., terr. crét. II, pl. 186 bis, figs. 13-17) and by Reuss (Denksch. Akad., Wien, 1854, VII, pt. I, pl. 29, fig. 4,) most probably belong to species of the *Liotiidæ*.

We have nothing to add from the cretaceous deposits of South India.

LII. *Family,—TURBINIDÆ.*

H. and A. Adams, Gen. I, *Trochidæ, ex parte*, pp. 389–403; Gray, Guide, 1857, *Turbinidæ*; Chenu, Man. I, *Trochidæ, ex parte*, pp. 342-351.

The animals of the *Turbinidæ* in respect to general form of the body and the dentition are in no way particularly different from those of the related families. They generally have a short, not retractile, rostrum; long tentacles, short eye-peduncles, the necklobes and also the lateral fringe well developed, and the operculigerous lobe generally provided with a few long cirrhi.

The principal characteristic lies in the presence of a thick calcareous coat on the outer side of a thin, generally paucispiral operculum. There must be some reason for the secretion of this calcareous mass, probably resting in a peculiarity of the operculigerous lobe.

The shells are of very different form, though always turbinate, but either smooth or variously ornamented, with rounded or angular whorls.

We include three sub-families in the *Turbinidæ*, namely, *phasianellinæ*, *turbininæ*, and *astraliinæ*.

a. *Sub-family,—PHASIANELLINÆ.*

eutropiinæ, H. and A. Adams' Gen. I, p. 389; *eutropiana*, Gray, Guide, 1857, p. 145; *phasianellinæ*, Chenu, Man. I, p. 342; *Phasianella* auctorum.

In the large species of the *phasianellinæ* the neck-lappets are very large and ciliated, while in those of small size they are said to be wanting; the fringe at the upper part of the foot is always very small, but still traceable; the foot is very narrow and divided by a longitudinal furrow; the operculigerous cirrhi are three on each side and of considerable length. Operculum ovate with a smooth, thick, calcareous coat.

The shells are *porcellanous, polished, ovate or turbinate, generally smooth, aperture ovate with the margins posteriorly not united, and the inner lip smooth.*

The following generic and sub-generic distinctions have been proposed:—

1. *Phasianella*, Lamck., 1804, has been restricted by H. and A. Adams (Gen. I, p. 389) for the larger species, in which the neck-lappets are well developed; the shell is ovate, smooth and polished; aperture ovate with the inner lip moderately thickened; columella solid; the outer lip is sharp.

1 a. *Tricolia*, Risso, 1826. This name has been reserved for the small *Phasianellæ*, which are said to have the neck-lobes not well developed, though this has by no means been satisfactorily proved. Except in the small size the shells do not offer any essential distinction from *Phasianellæ*, on which account this group can hardly be considered even of sub-generic value; but it is probable that the inflated forms, which are at present included in that sub-division, may in time be considered as the types of distinct genera.

2. *Chromotis*, A. Adams, 1863 (Ann. mag. nat. hist., XI, p. 19), has been proposed for species, like *Phas. neritina*, Dunk., from the Cape of Good Hope. *The shell is ear-shaped, thin, polished; spire very short; whorls few, rapidly enlarging; aperture oval, columella flattened and solid.* The operculum is calcareous.

3. *Leiopyrga*, A. Adams, 1863 (Ann. mag. XI, p. 19). *Shell turbinate, thin, smooth, polished; aperture semicircular, shorter than the spire, inner lip thin, columella incurved, excavated.* The type is *Leiop. picturata*, the locality, where it was found, not being known.

4. *Eucosmia*, Carpenter, 1864 (Ann. mag. XIII, p. 475). *Shell turbinate, solid, smooth; aperture with the margins nearly continuous, but not callous; columella slightly excavated.*

The PHASIANELLINÆ, or at least forms in every way identical with them, begin in the lowest sedimentary formations, and are most numerous during the mesozoic period, from the expiration of which they somewhat decrease. The recent species will amount to about 60; they are found in all parts of the tropical and sub-tropical seas, but are never very numerous.

Pictet gives in Mat. Pal. Suisse, 3me. Ser., pp. 462-463, a list of 14 species from the cretaceous deposits of Europe. In this list the *Ph. gosauica* and *conica* of Zekeli have to be considered as identical under the former name. *Phas. Reussiana*, Stol., has been proposed for another Gosau-species, which has erroneously been identified by Zekeli with *Ph. ervyna* of d'Orbigny (vide Stoliczka, Revision der Gosau-Gast., etc., p. 57—Sitz. Akad., Wien, 1865, LII). The *Ph. involuta*, Giebel=*Pyramidella id.* of Müller, has most probably nothing to do with this genus. From America three species are known and from Eastern Asia one. Within the last few years there have not been any additions made to this number of cretaceous species, which so far as they have been represented by reliable figures and descriptions, appear to belong without exception to the genus *Phasianella*, as restricted.

Phas. Absalonis, Fraas (Würtemb. nat. Jahreshefte, XXIII, 1867, p. 240), does not belong to this genus, but more probably to *Trochactæon.*

I have to report from the South Indian cretaceous rocks three species, one of which, *Ph. incerta*, has already been described by Prof. Forbes; and two are new, *Ph. globoides* and *conula*. Thus the total number of cretaceous *Phasianellæ* at present amounts to about 20 species.

LXXXI. PHASIANELLA, *Lamarck*, 1804.

1. Phasianella incerta, *Forbes*, Pl. XXIII, Figs. 17-19.

1846. *Phasianella incerta*, Forbes, Trans. Geol. Soc. Lond., VII., p. 123, Pl. XIII, Fig. 8.
1850. *Fusus subincertus*, D'Orbigny, Prod. II, p. 229.

Ph. testa ovato-elongata, levigata, anfractibus numerosis, convexiusculis, sutura impressa junctis composita; ultimo anfractu inflato, spira altiore; apertura ovata, postice valde acuminata; labio sinuoso, subcalloso, labro ad marginem tenui.

Spiral angle 48°—52°; sutural angle 8°—10°.
Approximate height of spire : total of shell (consd. as 1·00) ... 0·44.
Height of penultimate whorl : its width („ „ „) ... 0·39.

Shell ovately elongated, composed of numerous volutions, which are convex and separated by a deep suture, the spire being rather elevated, but shorter than the last whorl. The surface is smooth; aperture ovate, posteriorly narrow and pointed; the inner lip sinuous and somewhat thickened, outer lip thin, and anteriorly broadly produced.

Prof. Forbes was perfectly correct in stating, that he has "little doubt that better specimens will show" the species "to be *Phasianella*." Our specimen, which is represented in Fig. 19, has the margins of the aperture perfect, though the specimen itself is a good deal distorted by lateral pressure. D'Orbigny's generic correction of this species has no foundation whatever.

Localities.—Karapaudy, in yellowish conglomeratic sandstone; Alundana-pooram, in whitish, soft and fine grained sandstone; E. of Garudamungalum, in bluish, hard sandstone; rare. One specimen from the neighbourhood of Veraghoor measures about 160 mm. in height, and 100 mm. in width of the last volution. This species is one of the largest shells from the cretaceous beds of South India.

Formation.—Arrialoor and Trichinopoly groups. To the former the first named locality belongs.

2. Phasianella globoides, *Stoliczka*, Pl. XXIII, Fig. 16.

Phas. testa ovato-globosa, tenui, spira brevi, subobtusa; anfractibus paucis, convexis, sutura impressa junctis, striis incrementi crassiusculis notatis; apertura ovata.

Spiral angle about 80°; sutural angle 10°.
Approximate height of aperture : total of shell (consd. as 1·00) ... 0·66.
Height of penultimate whorl : its width („ „ „) ... 0·30.

This species is well characterized and easily distinguished by its remarkably globose form, short spire, convex volutions, and the distinct transverse striæ of growth, the shell being otherwise smooth and thin. The suture is impressed; the aperture oval; the columella moderately thickened and at its termination somewhat twisted.

Locality.—Olapaudy, in soft, finely oolitic rock; very rare.

Formation.—Arrialoor group.

3. PHASIANELLA CONULA, *Stoliczka*, Pl. XXIII, Fig. 15.

Ph. testa subconica, spira acuminata, moderate-longa; anfractibus 6, *paululum convexis, levigatis, sutura impressa junctis, ultimo subinflato, spira aliquantum altiore; apertura ovali, postice acuta, antice lata atque rotundata, labio crassiusculo, labro tenui.*

Spiral angle 64°; sutural angle 7°.
Height of aperture : total of shell (consd. as 1·00) ... ... 0·57.
„ of penultimate whorl : its width („ „ „) ... ... 0·50.

A small, conical shell, composed of about six volutions, which are slightly convex and smooth. The last whorl is somewhat more inflated in proportion with the rest, and higher than the spire. The aperture is oblique, posteriorly remarkably pointed and anteriorly broadly rounded; the outer lip is sharp, the inner lip somewhat thickened. There is a very slight indication of a fissure.

This species resembles in form *Ph. Sowerbyi*, d'Orb. (*Ph. striata*, Sow.) from the Blackdown Greensand, but it has no trace of spiral striation.

Locality.—S.-W. of Comarapolliam; very rare.

Formation.—Arrialoor group.

b. *Sub-family,—TURBININÆ.*

H. and A. Adams, Gen. I, p. 391; Chenu, Man. I, p. 343; Gray, Guide, 1857, *TURBINA*, p. 142.

The shells of the *TURBININÆ* are distinguished by their convex, *generally thick whorls and a subcircular aperture, the margins of which are internally usually callous and smooth, while the edge of the outer lip is sharp, more or less undulating, according to the presence or absence of spiral ribbings on the external surface;* the operculum has a round shape similar to the aperture, and mostly consists of a few rapidly increasing whorls.

The genera constituting this sub-family are generally known to conchologists under the old name *Turbo* of Linné. Philippi, though admitting the necessity of generic sub-divisions in *Trochus*, objects to them in *Turbo*, and Deshayes groups the species into "umbilicated" shells and such as have a "perforated" or solid columella. Generic distinctions in the *TURBININÆ* are not very urgently required, because the number of recent species is not very large, yet when we come to class the fossil species, the divisions pointed out by H. and A. Adams, Gray and others, are at least extremely convenient, and they ought, therefore, to be accepted unless direct proofs to the contrary can be given through the examination of the shells and animals.

The following genera will be found recorded in the works above mentioned:—

1. *Turbo*, Linné, 1858 (H. and A. Adams, Gen., I, pp. 391 and 392).

It seems to me that it is really impossible to determine any limit between the species referred by H. and A. Adams to *Turbo* and those called *Senectus*. The only way partially to retain that distinction would be to restrict the former name

to the smooth species only and the latter to the ribbed ones, but when large series of the same species, as, for instance, of *T. argyrostoma* are compared, it will be seen that in some localities all the specimens are spirally ribbed, while in others they are less so, and again in others they are almost smooth. According to the degree of these spiral ribbings, the anterior margin of the aperture is more or less produced into a distinct lobe; this one again is channelled in young specimens, solid and flat in old ones, the former having at the same time the columella distinctly hollowed out, the latter covered with the callosity of the inner lip.

2. *armaticus*, Gray, 1840 (*ibid.* p. 393).

2*a*. *Ocana*, Adams, 1862 (Proc. Zool. Soc., Lond., p. 143), proposed for *S. helicinus*, Born, as a type.

3. *Marmarostoma*, Swains., 1840 (*Lunella*, Bolt., in H. and A. Adams' Gen. I, p. 393).

4. *Modelia*, Gray, 1850 (*ibid.* p. 394).

5. *Prisogaster*, Mörch, 1850 (*ibid.* p. 395) ought probably not to be generically distinguished from *Turbo*.

6. *Callopoma*, Gray, 1850 (*ibid.* p. 395).

7. *Ninella*, Gray, 1850 (*ibid.* p. 396).

8. *Collonia*, Gray, 1852 (*ibid.* p. 396).

The number of fossil species described under the name of *Turbo* is very large, but I do not think that more than one-half of them really belong to this sub-family. When speaking of the *Littorinidæ* I have already remarked that several of the fossil species of *Turbo* appear to belong to *Amberleya*, and one or two have to be considered as the types of new genera. The large species of *turbininæ* do not appear to have been formerly so numerous as they are at the present; they are, however, found represented already in the palæozoic formations. Smaller species resembling the recent *Collonia* are very common in all secondary deposits; they are, however, difficultly distinguished from similar *trochinæ*, because the opercula are extremely rarely preserved.

No generic classification of the cretaceous *turbininæ* has as yet been attempted, and I do not think that such an attempt would be followed by any success, if conclusions be derived only from the descriptions and figures. The most careful examination of the original specimens and their comparison with recent generic type-specimens will be the only way to insure certainty as to the correctness of the determination. There can be little doubt that most of the genera, as above quoted, are found represented already in cretaceous beds. I may mention species like *Turbo Jaccardi*; Pict. and Camp., *T. Villersensis* and *Urgonensis*; *T. Thurmanni*, P. and C., and *T. Rouyanus*, D'Orb.; *T. Brunneri* and *T. Coquandi*, P. and C., and others which successively belong to *Turbo*, *(Senectus)*, *Sarmaticus*, *Callopoma*, *Collonia*, and others. We have no species of *turbininæ* to report from South India, which seems rather remarkable, as several of the recent species are very common in these seas.

c. *Sub-family,—ASTRALIINÆ.*

Shells helicoid, more or less depressed, usually with concave basis, ornamented with spiral ridges, which often are spinose or tuberculated on the periphery of the last whorl; aperture depressed, roundish; operculum oval, consisting of a few rapidly enlarging whorls.

As regards the form of the shell and that of the aperture the species belonging to the present sub-family form a transition to the *Trochidæ*, to which they previously have been referred, though their opercula are always provided with a thick calcareous coating and generally have a characteristic oval shape.

The following genera have been distinguished:—

1. *Astralium*, Link, 1807, (H. and A. Adams, Gen. I, p. 397) as restricted for the depressed and umbilicated species.

2. *Calcar*, Montf., 1810 (*Stella*, Klein, in H. and A. Adams' Gen. I, p. 398); this includes the species with a more convex basis and a solid columella. Klein (Ostrac., pp. 9-10) proposed for species, which apparently belong to the two last genera, the names *Sol*, *Luna*, *Stella* and in part also *Cricostoma*. It is difficult to give priority to any of these names, because the figures are not characteristic.

To *Calcar* probably also belongs *Turboidea*, Seeley, which was proposed for a fossil species, *T. nodosa*, from the Cambridge Greensand. It only differs from the former by a narrow umbilicus, which is, however, equally well developed in young specimens of *Calcar* (see Ann. mag. nat. hist., 1861, VII, p. 288, pl. 11, fig. 14).

3. *Guilfordia*, Gray, 1850 (*ibid.* p. 399) differs from *Calcar* by having the whorls more depressed and the last one ornamented with a number of long peripherical spines.

4. *Uvanilla*, Gray, 1850 (*ibid.* p. 400). The shells of this genus are distinguished by a pyramidal form and solid columella, being truncated anteriorly.

5. *Pachypoma*, Gray, 1850 (*ibid.* p. 400).

6. *Lithopoma*, Gray, 1850, (*ibid.* p. 401).

7 (5*a*?) *Pomaulax*, Gray, 1850 (*ibid.* p. 402).

8 (6*a*?) *Cookia*, Lesson, 1832 (*ibid.* 402).

9 (2*a*?) *Bolma*, Risso, 1826 (*ibid.* 403).

Gray in his Guide of 1857 accepts the five last named genera exactly in the same way as do H. and A. Adams, but Chenu recognizes only the first one, *Pachypoma*, as a genus and the other four as sub-genera. I have no materials of recent species to compare, but it seems to me that the old *Trochus undosus*, Wood, which is the only species of *Pomaulax*, is in reality not generically distinct from *Pachypoma*, and likewise the *Cookia sulcata*, Martyn, sp., not distinct from *Lithopoma*; nor do I see any special reason for distinguishing *Bolma* from *Calcar*; and thus we would have only six genera as constituting the sub-family, *Astralium*, *Calcar*, *Guilfordia*, *Cookia* or *Lithopoma*, *Uvanilla*, *Pachypoma*.

The *ASTRALIINÆ* appear to have a large number of representative species in the fossil state, and several very interesting forms can be traced in the oldest sedimentary formations, though they have not as yet been discriminated from *Trochus* and *Turbo*. My attention was first attracted to the existence of *ASTRALIINÆ* in cretaceous formations by the occurrence of a large number of oval, calcareous opercula, which I had collected in the Gosau-deposits at different localities in the Alps. D'Orbigny, Reuss and others have figured such opercula. After having compared several of the species, formerly described by Zekeli under the name of *Delphinula*, occurring in the same beds as those oval opercula, with recent species of *Astralium* and others, I have been able to ascertain their generic identity. Thus in my revision of the Gosau-Gastropoda (Sitz. Akad., Wien, 1865, LII, p. 539, etc.) I have quoted *Astralium muricatum, granulatum, radiatum, grande*, and *Guilfordia spinosa*. I might indicate a good number of other cretaceous species, but not having seen the originals I cannot vouch for the accuracy of their determination; *Turbo Martinianus*, D'Orb., of which *T. Pictetianus* probably is only a young specimen, *T. Mailleanus*, D'Orb., *T. Renauxianus*, D'Orb., *Turbo Crivelli*, Pictet and Camp. and others appear to belong to *Calcar; tomatia ornatissima*, Coquand (Étage Apt. de l' Espagne, 1865, pl. 5, fig. 4), *Trochus Goldfussi*, Binkhorst (Monog. Gast. et Ceph. craie de Limbg., 1861, p. 51, pl. 3, fig. 13), and others to *Astralium*, etc.

I shall describe from the South Indian cretaceous deposits four species in this sub-family, *Astralium carnaticum*, Stol., *Calcar jugosus*, Stol., *Uvanilla Rajah*, Forbes, sp., and *Lithopoma* (*Cookia*?) *intersecta*, Stol.; none of the species are as perfectly preserved as would be desirable, but still as to the generic determination of the two first named there can be little doubt, while the two others are more uncertain.

LXXXII. ASTRALIUM, *Link*, 1807.

1. ASTRALIUM CARNATICUM, *Stoliczka*, Pl. XXV, Fig. 2.

Ast. testa crassa, suborbiculari, spira paulo elevata, apice submammillato; anfractibus supra planiusculis, spiraliter multiliratis, ad suturam subtuberculatis, liris subrugosis notatis; ultimo ad peripheriam obtuse angulato, ad basin convexo atque lirato; umbilico aperto; apertura fere quadrangulari.

Spiral angle about 135°.
Approximate height of the shell : diameter of the basis (consd. as 1·00) ... 0·62.

Shell large, thick, suborbicular, with a short spire; whorls above flattened and ornamented with about 6-8 slightly undulating or rugose ridges, and near the anterior suture with a number of obtuse tubercles. The last whorl is angular at the periphery, and then gradually curving in the convex basis. On the angle, which separates the upper flat from the peripherical obtuse portion of the whorl, there are a number of rounded tuberculations present, but they generally become less distinct when they approach the aperture. The entire surface is

covered with spiral ridges, each measuring about one mm. in thickness and separated by equally broad furrows. There is no distinct granulation to be observed on the ridges, but they appear to be a little rough. The umbilicus is large, and the aperture nearly quadrangular.

This species in general form and ornamentation very much resembles *Astrálium muricatum*, Zek. sp., from the Gosau-deposits of the Alps (Sitz., Akad., Wien, 1865, LII, p. 539, and Abhandlungen Geol. Reichs-Anst., 1852, vol. I, pt. I, p. 57, pl. 10, figs. 7, 10, 11), but it is distinguished by the want of distinct tubercles or spines on the spiral ridges, which are also more numerous than in the European form.

Locality.—Moraviatoor, in brownish, calcareous sandstone; only a few, not perfectly preserved specimens have as yet been obtained.

Formation.—Ootatoor group.

LXXXIII. CALCAR, *Montfort*, 1810.

1. Calcar jugosus, *Stoliczka*, Pl. XXV, Fig. 5.

Cal. testa late-conica, crassa; anfractibus sub-applanatis, spiraliter quatuor jugis acutiusculis, sublevigatis ac æquidistantibus notatis; basi plana, haud umbilicata; apertura quadrangulari, depressa.

Spiral angle 86°; sutural angle about 8°.
Approximate height of shell : diameter of the basis (considered as 1·00) ... 0·72.
„ „ of one whorl : its width ... („ „ „) ... 0·23.

A very distinct, broadly conical, thick shell, which has each of the whorls ornamented with four sharp and slightly undulating ridges. Two of these are placed at the respective anterior and posterior margins of the whorls, and two in the middle; they are separated by three equally broad and deep furrows. The surface of the shell appears to be otherwise smooth. The basis of the last volution is flat, not umbilicated, but the columella and a neighbouring portion of the inner lip are strongly thickened and callous; the aperture is quadrangular, much broader than high.

I am not acquainted with any cretaceous species which could be compared with this remarkable shell. The ridges show only a very slight undulation, but no spines or tubercles, still I do not think that the species could belong to any other known genus. The general form of the shell, the thickened solid columella and the strong inner lip perfectly agree with species of *Calcar*.

Locality.—Moraviatoor, in brownish, calcareous sandstone: only the figured specimen, which is in many respects rather imperfect, has as yet been found.

Formation.—Ootatoor group.

LXXXIV. UVANILLA, *Gray*, 1850.

1. (?) Uvanilla Rajah, *Forbes*, sp. Pl. XXVIII, Fig. 12.

1846. *Trochus Rajah*, Forbes, Trans. Geol. Soc., Lond., VII, p. 120, Pl. XIII, Fig. 12 ; *idem* d'Orbigny. Pictet, et alii.
1862. *Craspedotus Rajah*, Ryckholt, Journ. de Conch. X, p. 414.

'*T. testa conoidea, anfractibus* (6) *tumidis, subangulatis, superne depressis, oblique plicatis, plicis distantibus (in anfractibus superioribus incompletis) longitudinaliter (i. e. transversaliter) sulcato-striatis ; basi convexa ; apertura quadrangulari*' (Forbes, *loc. cit.)*

We re-produce with slight alterations Forbes' figure of the only specimen that has yet been obtained. It is in many respects very incomplete, and the generic determination remains, therefore, doubtful, because the species may be proved to be a *Chlorostoma* or some other genus allied in form. The columella is solid, twisted, and terminates anteriorly with a strong obtuse point. The whorls are ornamented with transverse ribs, of which about three in each circuit are stronger than others ; they also produce deeper sulcations on the cast. The basis of the last whorl is rather angular, and when the shell was preserved it was no doubt still more so. The number of spiral striæ in one whorl varies from 7 to 10.

Locality.—Pondicherry, in light coloured sandstone.

Formation.—Arrialoor group.

LXXXV. LITHOPOMA, *Gray*, 1850 (or COOKIA, Lesson, 1832).

1. Lithopoma (cookia ?) intersecta, *Stoliczka*, Pl. XXIV, Fig. 21; Pl. XXVIII, Fig. 15.

Lithop. testa turbinata, anfractibus convexis, striis ternis spiralibus, distanter subtuberculatis, atque nonnullis costis transversalibus, plus minusve crassiusculis ornatis, ultimo ad peripheriam rotundato ; basi convexa ; apertura subcirculari, labio crasso, antice obsolete sulcato, labro tenui ; columella solida.

Spiral angle 65° ; sutural angle 8°.
Approximate height of shell : diameter of its basis (consd. as 1·00) ... 1·12.
Height of one whorl : its width ... ... („ „ „) .... 0·50.

The single specimen in our collection is rather imperfect ; but the presence of transverse ribbings, some of which are stronger than others, and the solid columella being anteriorly somewhat flattened and grooved make the generic determination of the species rather probable. The whorls are convex, and each is ornamented with three subtuberculated striæ, two of which are placed near the middle and one near the anterior margin of the suture. Imperfect specimens of this species are distinguished from *Uvanilla Rajah* by the want of a twisted columella.

Locality.—Comarapolliam, in whitish sandstone ; very rare.

Formation.—Arrialoor group.

LIII. *Family,—TROCHIDÆ.*

The animals of the *Trochidæ* in external form and organisation are almost identical with those of the *Turbinidæ*, the three pairs of filamentous appendages on the sides of the operculigerous lobe are generally well developed, and often there are one or two additional pairs on the front part of the foot; the head lobes are usually small and occasionally wanting; the teeth of many of the genera are, according to Philippi, variable within certain limits, though always characterized by the large number of uniform laterals.

Shell conical, pyramidal, with flat, or ovately depressed, somewhat convex whorls, spiral lines and ridges generally present, transverse ribs rare; aperture quadrangular, occasionally somewhat depressedly roundish, margins posteriorly meeting at an angle, outer lip sharp at the edge, and very rarely externally thickened, inner lip very often terminating with a tooth; operculum horny, circular, consisting of numerous narrow whorls, with a central and often somewhat thickened nucleus.

Until within the last few years hardly more than half a dozen conchologists appeared inclined to accept the numerous generic distinctions of *Trochus*, as pointed out by Swainson, Gray, Philippi, H. and A. Adams and others. Still researches of late years, having been specially directed towards the careful examination of the animals and the relative comparison of the shells, have shown not only the great convenience, but in many instances the propriety of the application of distinct generic denominations. No attempt, however, has been made to classify the numerous fossil species according to the results obtained from the examination of the recent ones; and this indeed is not easily accomplished. For as those distinctions are in most cases based upon the differences in the columellar lip of full grown and perfectly well preserved specimens, it will readily be understood that this part of a fossil shell very often becomes obliterated by mineral matrix and is very difficultly exposed. There is occasionally no less difficulty experienced in determining whether a fossil shell be a young or a full grown specimen.

I shall give a list of the principal so called generic types of this family, appending short characteristics of those which more commonly occur in secondary deposits; of others, which are rarely or doubtfully reported fossil, it will suffice for the present to refer to H. and A. Adams' 'Genera', and other known conchological works.

To facilitate a review of the genera they might be arranged according to the general form of the shells into four sub-families, somewhat similar to those of the *Turbinidæ*, though perhaps not equally characteristic. We have representatives of all the four divisions in our South Indian cretaceous deposits.

a. *Sub-family,—GIBBULINÆ.*

Shell depressed, solid, interior margins thickened, generally striated or dentate.

1. *Gibbula*, Leach, 1826 (H. and A. Adams, Gen. I, p. 431). Shell conoidal, depressed, mostly narrowly umbilicated; aperture angularly roundish, both lips internally slightly thickened; columella sometimes terminating obtusely.

Species of *Gibbula* are very common in cretaceous deposits. I may mention *Troch. Requienianus*, d'Orb., *Turbo Goupilianus*, d'Orb., *Turbo Brunneri*, *T. Coquandi*, *T. Viteli*, *Trochus Desori*, *T. Couloni* of Pictet and Campiche (see Mat. p. l. Pal. Suisse, 3me. Ser.), *Turbo arenosus*, Sow. (Sitz. Akad., Wien, LII, p. 534), *Turbo inflexus*, *scaliformis*, *Herklotsi*, *granuloso-clathratus* and *Zekelii* of Binkhorst, all belonging to the same type, as do *Turbo Strombecki*, *rimosus*, *granulose-cinctus*, *clathratus*, *rudis*, *filogranus*, *cariniferus* of the same author (Monographie Gast. et. Ceph. craie de Limbourg, 1861). It would not be surprising if all the last named forms from Maestricht were proved to belong only to one or two really distinct species, in one of which the spiral striæ are more equal and almost smooth, in the other granulated and alternately thicker and thinner.

Seeley describes from the Cambridge Greensand (Ann. Mag. Nat. Hist., 1861, VII, p. 290, pl. 11, fig. 16) a *Tr. levistriatus*, which he provisionally refers to *Gibbula*. The shell of this species is rather thin, depressed, broadly conical, the whorls are squarish and spirally striated, base umbilicated. It seems very probable that a new generic name must be proposed for this shell, if it does not belong to *Margarita*. I have described another species of the very same type from the Alpine Lias, *Trochus rotulus*, and also noticed the characteristic form and thin structure of the shell (Sitz. Akad., Wien, 1861, XLIII, p. 173, pl. 2, fig. 7).

I shall note two new species, *Gib. Jerdoniana* and *granulosa*, from the South Indian cretaceous rocks.

2. *Diloma*, Philippi, 1845. Shell conically depressed, like *Gibbula*, smooth or spirally striated; the umbilical region is covered with a thin, porcellanous expansion of the columella, forming an elevated ridge on the inner side of the labrum, but not uniting with the same (H. and A. Adams' Gen. I, p. 419, Philippi, Handbuch, 1853, p. 209).

3. *Oxytele*, Philippi, 1847, only differs from the last genus in having the porcellanous expansion thin and gradually uniting with the labrum; the type is *Trochus merula*, Chem.

A characteristic species occurs in our cretaceous rocks of South India, *Ox. notabilis*, which is the only cretaceous form fairly to be placed in this genus. There are, however, from the jurassic deposits a large number of species known (like *Troch. Belus*, *Acmon*, *Halesus*, *Pollux*, *Diomedes*, *Labadyei*, described by D'Orbigny in his Pal. française, ter. jur. vol. II; *Troch. obsoletus*, Morris and Lycett, and others, which most probably ought to be referred to the present genus, or partially to *Diloma*.

The recent species of *Diloma* chiefly inhabit South America and Australia; those of *Oxytele*, the Mediterranean and eastern seas.

4. *Monilea*, Swainson, 1840, is characterized by a large umbilicus surrounded with a striated or undulated callus; the inner lip is indented, having two or three small tubercles, in which the internal striæ of the umbilicus terminate; the shell itself is rather solid.

Several jurassic species appear to belong to *Monilea*, like *Turbo Calypso* and *Eudoxus* of d'Orbigny and others, but I am not acquainted with any from cretaceous rocks.

H. and A. Adams (Gen. I, p. 431) consider *Solariella*, S. Wood, as a subgenus of *Monilea*, but I rather think that it is more closely allied to *Margarita*, and shall notice it subsequently.

5. *Clanculus*, Montfort, 1810 (H. and A. Adams, Gen. I, p. 415).

6. *Monodonta*, Lamarck, 1799 (*ibid.* p. 417; *Labio*, in Philippi's Handb., p. 209). There have been a few cretaceous and jurassic species described under the last named genus, but I do not think correctly, as none of them show an

internally thickened and crenulated layer. Characteristic species of both genera are first known with sufficient accuracy from the tertiaries.

7. *Craspedotus*, Philippi, 1847, (*Otavia*, Gray, Cat. 1857, p. 158). Shell globular, thick, ornamented like *Monodonta;* inner margin of the aperture thickened and crenulated, umbilical region impressed, flattened, but not hollowed out, outer lip externally with a conspicuous varix (see H. and A. Adams' Gen. I, p. 417, and Philippi's Handbuch, p. 209). The type of the genus is the Mediterranean *Craspedotus Otavianus*, Cantraine, or *Cr. limbatus*, Phil., for which Brussina again lately proposed the sub-generic name *Danilia* (Verhandlg. Zool. Bot. Gesellsch. Wien, 1865, vol. XV, p. 25).

Ryckholt (Journ. de Conch., 1862, X, pp. 415-417) enumerates in his Catalogue of *Craspedotus* 38 species, of which no less than 35 are from cretaceous rocks, two being tertiary and one recent.

The larger number of the cretaceous species are described in the second part of the author's "Mélanges paléontologiques," which, I am sorry to say, we have not as yet been able to obtain in Calcutta. With regard to the few other species quoted by Ryckholt from the Paléont. française of d'Orbigny, I must express great doubt as to their belonging to *Craspedotus*. The internal thickened and crenulated margins of the recent *C. limbatus* are very characteristic, but not to be found in any of the cretaceous species with which I am acquainted. I do not see any benefit to be derived from such shifting about of species into different genera without previously stating the reasons which make one determination more probable than the other. Suggestions of those generic transfers can always be made, but they must be first confirmed by the examination of the originals, or of other better preserved specimens, before the new generic determinations are really introduced into the literature of the family.

8. *Euchelus*, Philippi, 1847 (H. and A. Adams' Gen. I, p. 418,—*Aradasia*, Gray, Cat. 1857, p. 158,—Philippi, Handb., p. 209). The shell is characterized by its oval or sometimes nearly globular form, convex whorls ornamented with granular ridges and a solid or slightly excavated columella; the aperture is roundish, internally somewhat thickened and striated, the outer lip being obtuse on the edge and crenulated, the inner usually with one or more slight tubercles. This genus only differs from *Monilea* by the want of a callous edge to the umbilicus.

A large number of jurassic species very much resemble in external ornamentation the recent species of *Euchelus*, but in most of them no teeth or tubercles are known on the inner lip, the aperture being almost circular, like in *Delphinula*. Of cretaceous species *Turbo solitarius*, Stol. (Sitz. Akad., Wien, 1865, XVLII, p. 534) *Trochus dentigerus*, d'Orb., *Turbo Yonninus*, d'Orb., *T. decussatus* and *Goupilianus*, d'Orb., *Troch. crucianus*, Pictet and Camp., may belong to this genus. We shall notice one species, *Euchelus ornatus*, from the South Indian cretaceous rocks.

9. *Omphalius*, Philippi, 1847 (H. and A. Adams' Gen. I, p. 429,—Philippi's Handb., p. 210), is also closely allied to *Monilea*, and only differs from it by having the callus on the edge of the umbilicus very distinct; the inner lip is almost straight, sometimes with one or two tubercles, the columella not twisted.

10. *Trochiscus*, Sowerby, 1838 (H. and A. Adams' Gen. I, p. 432).

11. *Chlorostoma*, Swainson, 1840 (*ibid.* p. 428) is distinguished by its broadly conical and depressed form, the columella is hollow, the inner lip always thickened, more or less covering the umbilical region; the whorls are generally spirally striated and transversally rugose.

The only cretaceous species which probably belongs to this genus is *Turbo plicatilis*, Desh. (d'Orbigny, Pal. franç. terr. crét. II, pl. 183, figs. 11–13). *Tr. crucianus*, P. and C., which I have mentioned under *Euchelus*, has also the general form of the recent *Chlorostoma*, but not the thickened lip, and the tooth is rather median than terminal.

12. *Trochocochlea*, Klein, 1757 (Ostrac. p. 42, pl. 2, figs. 53–54;—H. and A. Adams' Gen. I, p. 425—*Osilinus*, Phil., Handb., p. 210—*Labio* apud Gray, Cat. 1857, p. 155). Shell ovately conical, solid, smooth or spirally ridged, not umbilicated, but with the inner lip flattened, concave anteriorly, provided with a tooth at the termination of the columella. Klein's figures of two species are very characteristic and entitle his name to priority.

This is a very important genus in fossil Conchology; numerous jurassic species belong to it, like *Turbo bicinctus*, d'Orb., *T. castor*, d'Orb., *Troch. Pietti*, Heb. et Desl., *Monod. Lyelli* and *formosa*, Morris and Lycett, *M. comma*, *M. Waltoni*, *M. tegulata*, *M. arata* of Lycett and many others.

Of cretaceous species I may mention *Trochus Marollinus*, d'Orb., and *T. Dupperreyi*, d'Arch.

13. *Tegula*, Lesson, 1832, is considered by Gray (Cat. 1857, p. 153) and others as a distinct genus. The type is *T. pellis-serpentis*, which is not only distinguished by its more pyramidal form and granulated whorls, but especially by a broad callosity covering the concave umbilical region; the columella is twisted and terminates with an obtuse point.

14. *Livona*, Gray, 1842 (H. and A. Adams, Gen. I, p. 412,—*Cittarium*, Phil., 1847, Handb. p. 210); the type is *Turbo pica*, Linn., which is specially characterized by a toothlike process at the entrance of the umbilicus; the shell is broadly conical, solid, smooth; aperture roundish with the margins single, the outer one sharpened on the edge.

b. *Sub-family,—TROCHINÆ.*

Shell pyramidal or subturreted, columellar lip anteriorly truncated, base of shell flattened or concave.

15. *Carinidea*, Swainson, 1840 (*Infundibulum*, apud H. and A. Adams, Gen. I, p. 415;—*Trochus, ex parte* in Gray's Cat. 1857, p. 148;—*Polydonta ex parte* in Philippi's Handb., p. 209). The type of this genus is *Troch. concavus* of Linné, having the periphery of the last whorl strongly carinated, somewhat similar to *Xenophora* or *Infundibulum;* the base is strongly concave, the inner lip generally smooth and anteriorly very slightly obtuse, passing gradually into the outer lip. I have already (p. 316) remarked that the name *Infundibulum*, Montf., cannot be applied to this group of shells, but at the same time I believe that they ought to be generically distinguished from *Polydonta*, being more closely allied to the next genus. *Trochus Hammon*, Coquand (Const., pl. 2, fig. 9) from the cretaceous rocks of Algiers may belong to this genus.

16. *Trochus*, Linné, 1758 (H. and A. Adams, Gen. I, p. 412) as restricted for the species with a smooth, slightly bent inner lip, being posteriorly twisted and terminating anteriorly obtusely, but not being sensibly thickened; base concave in the centre, but not umbilicated.

17. *Cardinalia*, Gray, 1847 *(ibid.* p. 413), has the inner lip simply curved, not twisted posteriorly, thick, smooth, and in front terminating abruptly.

18. *Tectus*, Montf., 1810 *(ibid.* p. 413;—*Pyramis*, apud Gray and Philippi; *Pyramidea*, Swains.). Montfort appears to have figured the *Troch. Mauritianus*. Gmel., as the type of this genus, as this is the only species which occasionally has two rather strong fold-like teeth on the outer lip. The inner lip is in this genus *anteriorly* twisted and distinctly thickened, which is the only traceable distinction from *Trochus*, but it appears to be constant.

19. *Polydonta*, Schumacher, 1817 *(ibid.* p. 414); the margins of the aperture are in this genus generally somewhat thickened, the inner lip posteriorly twisted, then almost straight, toothed or tuberculated at the edge; the axial cavity is usually furnished with a few callous ridges.

20. *Ziziphinus*, Leach, 1840 *(ibid.* p. 421—*Caliostoma*, Swains., *ex parte)*. Shell conical, whorls generally flattened or slightly convex, inner lip thickened, gently curved, smooth, anteriorly terminating obtusely and mostly covering the umbilical region.

21. *Eutrochus*, Adams, 1863 (Proc. Zool. Soc., London, p. 506), has been proposed for a *Ziziphinus*-like shell, *Eut. perspectivus*, being remarkably thin and having a perspective umbilicus. Should this group include also the umbilicated *Ziziphini* which have a thicker shell?

Of all these six last named genera the species of *Ziziphinus* are most numerous in the present seas, and the same appears to be the case with the fossil ones. It is probably not an over-estimate to say that at least one-tenth of all the known species of *Trochus* from jurassic and cretaceous deposits belong to *Ziziphinus*. A great difficulty exists, however, in the correct determination of the genera, because the inner lip is, in the fossil species, very often not so perfectly preserved, or so thoroughly exposed as could be desired, and we must therefore in a great many cases make our determination solely dependent upon the general form of the shell.

The cretaceous species can be partially referred to *Tectus*, partially to *Ziziphinus*, imperfect specimens of both not being distinguishable from *Trochus*, and the same must be said with regard to *Eutrochus* as compared with the umbilicated species of *Ziziphinus*. Forms directly answering to the characters of *Polydonta* and *Carinidea* are not known from cretaceous deposits, although the *Pleurot. Scarpasensis*, d'Arch., has a great affinity to the last genus.

Species apparently belonging to *Tectus* are *Trochus Guerangeri*, d'Orb., *Tr. Couveti*, Pict. et Renev., *Tr. Renevieri*, Pict. et Camp. and others. I shall notice two new species from our South Indian cretaceous rocks, *Tectus tamulicus* and *junceus*, the former unquestionably belonging to this genus and the latter with the greatest probability. As characteristic species of *Ziziphinus* I may mention *Troch. striatulus*, Desh., *Tr. girondinus*, d'Orb., *Tr. Cordieri, Buneli, Huoti*, and *Rozeti* of d'Archiac (probably representing only one or two species); *Tr. Pertyi, Fischeri, Morteauensis, Laharpi, Gaudini, Buvignieri, Gessneri, Gillieroni* of Pictet and Campiche and others, described by Coquand, Reuss, Geinitz, Binkhorst and Guéranger (see Mat. p. l. Pal. Suisse, 3me. ser.). As more properly belonging to *Trochus*, on account of a conspicuous depression in the centre of the basis, I may quote *Tr. Zollikoferi, Chavannesi, Oosteri* of Pict. and Camp., *Tr. Razoumowski*, Pict. et Ren., *Tr. Marrotinus*, d'Orb. and others. From our cretaceous deposits I have to mention only one well known European species, *Ziziphinus Geinitzianus*, Rss., which generally has a narrow umbilicus, and thus is allied to the form designated by A. Adams *Eutrochus*.

22. I may mention here that the subconical or pyramidal fossil species the shells of which consist of numerous, plane and smooth whorls, like the cretaceous *Trochus frumentum*, Pict. et Camp., and probably *Tr. Astierianus*, d'Orb., or the jurassic *Troch. epulus* and *Actæon* of d'Orb., have to be distinguished as a separate genus.

23. The umbilicated, many whorled, spirally striated or smooth species, like the jurassic *Tr. late-umbilicatus*, *Tr. Mariæ*, *Tr. Cirrus* of d'Orbigny, *Tr. lautus*, Stol. and others, ought most likely also to form a distinct genus, while the allied species with a convex basis and square aperture appear more nearly related to *Niso*. There is a great want of any critical examination of all the varied forms of jurassic *Trochidæ*.

24. *Turcica*, H. and A. Adams, 1854 (Gen. I, p. 423). Shell rather thin, subconical, with solid columella, twisted posteriorly, inner lip with one or two fold-like teeth. H. and A. Adams only mention the Australian *T. monilifera*, A. Adams, being the type of the genus, but I rather think that there have been some additional species described since.

The only known fossil species which most probably belong to this genus are *Trochus** *Guyotianus*, *Tollotianus* and *Nicoletianus*, described by Pictet and Roux from the "Grès verts" of the neighbourhood of Geneva (Moll. foss. 1847-1853, pp. 202-204, pl. 19, figs. 8, 9, and 10). The last of these is doubtful, being only known from a cast, having the whorls rather roundish, and thus resembling *Troch. dentigerus*, d'Orb., which more likely belongs to *Euchelus*.

24 a. *(Trochodon)*, Seeley, 1861 (Ann. mag. nat. hist., VII, p. 289), not *idem*, Agass. pro *Trochidon*, Swains. This was proposed for a species, *Tr. cancellatus*, from the Cambridge Greensand. The shell resembles a *Ziziphinus*, is said to be thin, having on the columella two prominent teeth; it is therefore much more likely that it is generically not different from *Turcica*.

24 b. *Ptychostylis*, Gabb, 1865 (Proc. Calif. Akad., III, p. 187), according to the characteristics given by Gabb, apparently does not differ from *Turcica*. The columella is solid with two oblique folds; *P. caffea* from California is quoted as the type.

25. *Thalotia*, Gray, 1847 (H. and A. Adams, Gen. I, p. 420). The columella is in this genus solid, anteriorly twisted, tuberculated or spirally grooved, the aperture anteriorly sub-effuse. The conical shells are generally rather solid, with the outer lip internally somewhat thickened, the more depressed ones thinner and with the lip simply furrowed, but not markedly thickened. Recent species of *Thalotia* are said chiefly to occur in the Australian seas; one rather globose species was lately collected on the Ceylon coast by Mr. G. Nevill.

There are several species known from tertiary deposits, but I am not acquainted with any well preserved specimens from the cretaceous and from the jurassic rocks. I could only mention species like *Turbo Buvignieri* and *globatus*, d'Orb., which most nearly approach to it.

* Some other allied forms like *Turbo Golezianus* and *Saxoneti*, Pict. and Roux (Moll. Grès verts, pl. 19, figs. 14-15), *Turbo Dujardini*, Coquand (Const. pl. 2, fig. 8), and others appear to belong to *Amberleya* (p. 262), of the *Littorinidæ*.

26. *Cantharidus*, Montfort, 1810 *(ibid.* p. 423). Shell conoidal, generally rather thick, spirally striated or rugose; columella solid, smooth, rather straight, anteriorly terminating with a simple point.

Fossil species of *Cantharidus* are rare. There are very few known from the tertiary and the cretaceous deposits, while similar species from the jurassics are usually ornamented with some strong ridges or granulated striæ. From cretaceous rocks I may mention *Turbo Duperreyi* and *Raulini*, d'Arch., from the Tourtia-beds of Belgium. I shall note a new species *C. striolatus*.

27. *Elenchus*, Humphrey, 1797 *(ibid.* p. 424), only differs from the previous one by having the surface of the shell generally smooth, and the inner lip provided near the anterior termination with a conspicuous tooth.

28. *Alcyna*, Adams, 1860 (Ann. mag. nat. hist., V, p. 407), very much resembles *Elenchus*, but has a shorter spire and the inner lip is rather callous, terminating with a very strong tooth.

29 (?). *Bankivia*, Beck, 1848 *(ibid.* p. 425), with regard to its form is allied to *Elenchus*, but the structure of the shell which is not pearly within makes it very improbable that the genus belongs to the *Trochidæ* at all. The species may perhaps more correctly be referred to the *phasianellinæ* (of the *Turbinidæ*), and even this can be objected to, as the columella is very peculiarly twisted.

c. *Sub-family,—MARGARITINÆ.*

Shell thin, conically depressed, whorls rounded, columella excavated.

30. *Solariella*, Wood, 1842 (H. and A. Adams, Gen. I, p. 431), has been originally proposed for a broadly conical species* with rather strong spiral ridges and a large, crenulated umbilicus. S. Wood especially drew attention to the similarity of the shell to *Solarium*, being readily distinguished from it by the nacrous structure. H. and A. Adams quote *Solariella* only as a sub-genus of *Monilea*, but I have already noticed that the thin shell distinguishes it readily from that genus. The recent species of which there are only a few known are generally finely spirally striated.

Fossil species are numerous from the palæozoic formations upwards, and it seems very probable that several of the conical species described as *Solarium* belong rather to *Solariella*. Meek and Hayden (Proc. Phil. Acad., 1860, p. 423) also mention the frequent occurrence of these forms, when they propose for the *Sol. flexistriatum*, Ev. and Schum., the new generic name *Margaritella*, which must be considered as a synonym of *Solariella*. Another American cretaceous species is *Solariella Abboti*, Gabb, sp., and the same author lately described two from California, *Sol. (Marg.) crenulata* and *globosa* (Pal. Calif. I, 1864, pp. 118-119). European cretaceous species, like *Turbo inconstans*, *Astierianus* and *Goupilianus*, d'Orb., and others most likely belong to *Solariella*. I shall describe two from South India, one of which, *Sol. radiatula*, Forb., sp., is common to Europe, and has been described from different parts of Germany and Austria, and the other *Sol. strangulata* is new.

31. *Enida*, Adams, 1860 (Ann. mag. nat. hist., V, p. 408). Whorls ornamented with spiral and squamous striæ, sutures canaliculated, last whorl carinated at the periphery; inner lip somewhat expanded, and in the middle reflexed;

* *Solariella maculata*, S. Wood, from the Sutton Crag.

umbilical margin crenulated. The genus was founded upon two species, *E. japonica* and *speciosa*, which were dredged in deep (63 fathoms) water in the Japan sea.

Deshayes in his last edition of the Paris fossils describes several small species which perfectly correspond with the characteristics given by Adams. Of cretaceous species *Turbo Guerangeri*, d'Orb., and others, appear to be nearly allied in form, but they have a much thicker shell. *Turbo delphinuloides* and *T. Lyelli*, d'Arch., and others, seem to be representatives in the jurassic formations, but it is doubtful if the distinctions from *Solariella* are really of a generic value.

32. *Margarita*, Leach, 1819 (H. and A. Adams, Gen. I, p. 433). Shell suborbicular or conically elevated with short spire, thin, smooth or spirally striated, aperture nearly circular, margins slightly expanded, edge of umbilicus not crenulated. The recent species which are numerous mostly inhabit northern seas or in the tropics deep water, being therefore readily distinguished by their thin shells. The principal difference from *Solariella* consists in the want of a crenulated edge of the umbilicus and a more roundish aperture.

Tertiary species are rather rare, and of cretaceous I can only mention *Marg. Nebrascensis*, M. and H. (Proc. Phil. Acad., 1856, p. 54), and *M. abyssina*, Gabb, sp. (Smith. Miscell. Coll. No. 177, p. 18) from North America; a third species will be described under the name of *Marg. orbiculata* from South India.

d. *Sub-family,—DELPHINULINÆ.*

Shell orbicular or broadly conical, whorls tubular.

33. *Delphinula*, Lamarck, 1803 (*Angaria* in H. and A. Adams' Gen. I, p. 411). Whorls generally spirally ridged and often coronated, the last one at the aperture usually detached from the previous one, margins continuous, sharpened from within, sometimes a little enlarged, but not thickened.

The recent species of *Delphinula* are mostly of a large size and of a depressed form, with the whorls superiorly coronated. They are shells of the eastern and warmer seas, being rare in tertiary deposits, but more common in cretaceous. Species represented by the type *Del. turbinopsis*, Lamarck, are distinguished by their more slender form and elevated spire; they also are rather rare in tertiary and cretaceous deposits, being, however, very common in jurassic* and even in triassic rocks; last there are species represented by the *Delph. laxa*, Say, having the whorls almost smooth and more or less uncoiled. Of this form I only know the original figure of Say and that given by Chenu, but Mr. G. Nevill lately collected on the Ceylon coast a species which comes nearest to it, excepting that it has the first whorls regularly coiled, not detached from each other. The jurassic *Turbo Archiacii* and *Stomatia sulcosa* of d'Orbigny most probably belong to this type of *Delphinula*.

I have already remarked when speaking of the *LIOTIIDÆ*, that all the small species with transverse ribs and usually largely expanded and thickened margin of the aperture have nothing to do with true *Delphinulæ*. On this account many errors have been committed in fossil Conchology, because not only species of *Liotia*, *Craspedotus*, and *Cyclostrema*, but also of *Crossostoma*, *Chrysostoma*, *Umbonium*, *Straparolus*, and others have been at various times referred to *Delphinula*. It will still be some time before all these mistakes can be emended.

Of cretaceous species I consider the following as most probably belonging to *Delphinula*: *Turbo munitus*, Forbes, *T. Thurmanni*, Pict. et Camp., *Turbo sulcifer* and *Delphinula coronata* of Römer, *D. spinulosa*, Binkhorst (Monog. Gast. et. Ceph. craie, Limbg., p. 54). Gabb. (Pal. Calif., 1864, I, p. 121, pl. 20, fig. 78) describes an *Angaria ornatissima*, but I rather think the species to

* *Turbo Eudoxus*, *subfunatus*, *epulus and Davoustii*, d'Orb., *Turbo segregatus*, Heb. and Desl., and others.

be a *Solariella* or of some allied genus. Coquand's *Delph. numida* (Constantine, p. 181, pl. 3, fig. 7), though only known from a cast, is most probably a species of this genus, and as far as mere short description enables an opinion to be formed, it seems probable that the two French species described by Coquand as *Delph. scalaris* and *cretacea* are also correctly determined. I shall note a characteristic large species from our South Indian cretaceous deposits, *Delph. annularis*, and another somewhat doubtful, *Delph. rotelloides*, Forbes, sp.

Thus viewing in a general way the number of species representing the *Trochidæ* in the cretaceous period, we find that the true *trochinæ* are most numerous, being characterized by forms such as *Ziziphinus*, *Trochus*, *Tectus* and *Turcica*; next come the *gibbulinæ* represented by the genera *Gibbula*, *Trochocochlea* and *Euchelus*; then the *delphinulinæ*, and last the thin shells of the *margaritinæ*. The species are never very numerous in secondary formations, and where they occur they remain very local. Exactly the same may be observed in the recent *Trochidæ* which are strictly littoral inhabitants. The most interesting fact resulting from a careful study of the mesozoic forms is the indication of most of the present generic types as being in existence already at this remote period. Some of the genera, like *Turcica*, *Trochiscus*, *Solariella*, *Delphinula*, *Euchelus* and others which are rather rare recent, appear to have been formerly much more numerous, while the contrary seems to be the case with respect to *Clanculus*, *Monodonta*, *Polydonta* and others.

Most of our species of *Trochidæ** are from the uppermost beds of the South Indian cretaceous deposits, while those of the *Turbinidæ* are from the lowest.

LXXXVI. OXYTELE, *Philippi*, 1847.

1. Oxytele notabilis, *Stoliczka*, Pl. XXIV, Fig. 2.

Oxy. testa conico-ovata, apice obtusiusculo, anfractibus senis, convexis, sutura impressa junctis, levigatis; apertura oblique-quadrangulari, labro acuto, tenui; basi in medio callositate expansa tecta.

Spiral angle 70°; sutural angle 8°- 10°.
Height of shell : diameter of its basis (considered as 1·00) ... ... 1·16.
„ of one whorl : its width† („ „ „) ... ... 0·45.

Shell conically ovate with an obtuse apex; surface smooth; whorls six, convex, separated by an impressed suture, last roundish at the periphery; base slightly convex, covered by an expanded callosity which is united with the lip, and not forming any distinct thickening on the same; aperture obliquely angular, outer lip slightly expanded and thin.

I do not know a single cretaceous species which could be compared with this remarkable shell; it possesses all the characters of the genus *Oxytele*.

Locality.—Comarapolliam, in whitish sandstone; very rare.

Formation.—Arrialoor group.

* With the exception of *Delphinula*.
† The whorls ought to be a little wider in Fig. 2.

LXXXVII. GIBBULA, *Risso*, 1826.

1. Gibbula Jerdoniana, *Stoliczka*, Pl. XXIV, Figs. 6-7.

Gibb. testa late conica, apice obtusiusculo; anfractibus quinis seu senis, subconvexis, ad suturam sæpe paulo tumescentibus, spiraliter sulcatis: sulcis 6-7, *æquidistantibus; ultimo anfractu ad peripheriam rotundate-angulato; basi applanata, spiraliter striata, umbilico moderate-lato ac infundibuliformi instructa; apertura subquadrangulari, labio prope recto, labro tenui ad peripheriam valde insinuato.*

Spiral angle 75°-80°; sutural angle 10°-12°.
Height of shell : diameter of its basis (considered as 1·00) ... 0·34.
„ of one whorl : its width („ „ „) ... 0·90.

The broadly conical form and the funnel-shaped umbilicus are very characteristic distinctions of this shell, of which the nearest allies are several of the recent *Gibbulæ* from eastern seas. The apex is generally somewhat obtuse, the first whorls being a little flattened and in old specimens almost smooth, but on the other whorls the spiral sulcations generally are very distinct and crossed by fine oblique lines of growth. The posterior margin of the whorls is occasionally somewhat thickened. The basis is flattened and spirally striated similarly to the rest of the surface of the shell. The outer lip is remarkably deeply insinuated at the periphery, not thickened at the margin, the inner lip is, however, almost straight, terminating on the umbilical edge with a slightly obtuse point.

I have much pleasure in naming this species after our distinguished naturalist Dr. Jerdon, who has so largely contributed to our knowledge of the Indian Vertebrata.

Locality.—Neighbourhood of Comarapolliam, in whitish sandstone; rather rare.

Formation.—Arrialoor group.

2. Gibbula granulosa, *Stoliczka*, Pl. XXIV, Figs. 8-9; Pl. XXVIII, Fig. 14.

Gibb. testa conula, apice sub-acuminato; anfractibus senis seu septenis, convexiusculis, spiraliter striatis, striis inæqualibus, alternantibus, fortioribus sub-granulatis; basi sub-convexa, spiraliter dense striata, in medio funiculate-impressa, vix umbilicata; apertura sub-quadrangulari; interne circulari, marginibus interne paulo incrassatis, labro ad peripheriam profunde insinuato, labio recto antice applanato ac sub-sulcato.

Spiral angle 70°—72°; sutural angle 6°—8°.
Height of shell : diameter of its basis (considered as 1·00) ... 1·00.
„ of one whorl : its width ... („ „ „) ... 0·46.

This species is distinguished by the large number of spiral striæ, which alternate in thickness, the stronger ones being finely but distinctly granulated. The whorls are convex, somewhat constricted posteriorly; the basis slightly convex and densely spirally striated; there is not a very distinct umbilicus present, but only a deep, funnel-shaped depression in its place. The inner lip is nearly straight,

anteriorly flattened and provided with a short groove, the outer lip is thin, but both lips are internally somewhat thickened and united. This species very much resembles *Turbo (? Gibbula) arenosus*, Sow. (Stoliczka in Sitz. Akad., Wien, 1865, LII, p. 534) from the Alpine Gosau formation, but it has the spiral striation more closely arranged and stronger.

I am not certain whether this species is correctly placed in *Gibbula*, for it is almost quite as much allied to *Tegula*, but the columella does not appear to be twisted. Many *Ziziphini* also are very similar, but they all have the last whorl more angular.

Localities.—Vylapaudy, Comarapolliam, Arrialoor, in whitish sandstone; rare.

Formation.—Arrialoor group.

LXXXVIII. EUCHELUS, *Philippi*, 1847.

1. Euchelus ornatus, *Stoliczka*, Pl. XXIV, Fig. 10.

Euch. testa subconica, crassiuscula, apice obtusiusculo; anfractibus 4-5, *postice applanatis, deinde angulatis atque subconvexis, ultimo ad peripheriam rotundato, omninis postice striis spiralibus duabus, antice ternis granulatis ornatis, transversaliter striolatis; basi convexa, spiraliter granulato-striata, anguste umbilicata; apertura fere circulari.*

Spiral angle 76°; sutural angle 8°-10°.					
Height of shell	:	diameter of its basis (considered as 1·00)	...	...	1·10.
„ of one whorl	:	its width („ „ „)	...	...	0·40.

This species is distinguished by the posteriorly flattened whorls, which are near the suture ornamented with two thinner, and on the anterior nearly straight portion with three somewhat stronger granulated spiral striæ. Similarly granulated striæ are also on the basis of the last whorl, which is narrowly umbilicated. The transverse striæ of growth are very fine; the aperture is almost circular, the margins being internally somewhat thickened.

There is some doubt whether this species correctly belongs to *Euchelus*, as I have not been able to observe the characteristic tooth on the inner margin of the aperture, not being quite perfect, but the ornamentation, the form and thickness of the shell so thoroughly resemble several of the recent *Eucheli* that I could hardly believe it to be generically distinct from them, even were a labial tooth not distinctly developed.

Localities.—Veraghoor and Comarapolliam, in light coloured sandstone; rare.

Formation.—Arrialoor group.

LXXXIX. TECTUS, *Montfort*, 1810.

1. Tectus tamulicus, *Stoliczka*, Pl. XXIV, Figs. 4-5.

Tect. testa conica, spira regulari; apice mammillato; anfractibus circiter denis, planis, infra atque supra ad margines aliquantisper paulo tumescentibus,

junioribus spiraliter striatis, omninis striis incrementi minutis, obliquis notatis, ultimo ad peripheriam rotundate angulato; basi subconvexa, in medio impressa; apertura quadrangulari obliqua; labro ad basin margine tenui instructo, sinuoso; labio paulo incrassato; columella solida, antice torta atque incrassate terminanti.

Spiral angle 65°; sutural angle 5.°
Height of shell about equal to the diameter of the basis of the last whorl.
Height of one whorl : its width (considered as 1·00) ... ... 0·40.

Shell regularly conical, apex obtuse or mammillate, whorls flat, along the upper and lower margins often slightly thickened, in young specimens spirally striated, in all stages of growth, however, marked with fine oblique transverse striæ; last whorl roundish at the periphery; basis slightly convex, and in the middle somewhat depressed. The aperture is sub-quadrangular, very oblique, the outer margin being sharp, and laterally as well as at the basis deeply indented; the inner lip somewhat callous and smooth; the columella twisted and anteriorly terminating with a thickened point. In young specimens the last whorl is sharply angular at the periphery and flat at the basis.

This is a typical species of Tectus, and is closely allied to several recent forms from our eastern seas. It has the columellar lip very distinctly twisted anteriorly and thickened, thus being readily distinguished from species of *Trochus* (as restricted).

Of cretaceous species I may mention *Trochus Zollikoferi*, Pictet and Camp., (Mat. p. l. Pal. Suisse, 3me. Ser., p. 513, pl. 86, figs. 4-5) from the Urgonien of Switzerland, being distinguished from young specimens of *Tect. tamulicus* merely by the presence of a narrow umbilicus.

Locality.—Comarapolliam and neighbourhood of Arrialoor, in whitish sandstone; not rare.

Formation.—Arrialoor group.

2. Tectus junceus, *Stoliczka*, Pl. XXIV, Fig. 3.

Tect. testa regulariter conica, spira acuminata; anfractibus planiusculis, suturis vix impressis junctis, spiraliter jugis circiter septenis subtuberculatis atque approximatis instructis, ultimo ad peripheriam carina subrugosa instructo; basi applanata, spiraliter striata; apertura quadrangulari, columella solida et torta.

Spiral angle 32°; sutural angle 4°.
Approximate height of shell : diameter of its basis (consd. as 1·00) ... 1·24.
Height of one whorl : its width ... ... („ „ 1·00) ... 0·31.

This species is distinguished by its attenuated shape, and the large number of closely arranged, spiral ridges, which are ornamented with spirally elongated tubercles, and often alternate with others of lesser thickness. One or two of the anterior ridges, which are placed nearest to the suture, are generally somewhat stronger than the rest. All the tubercles of the respective ridges are arranged in transverse rows, having the appearance of indistinct ribbings. The surface of the shell is not perfectly well preserved, for it does not appear improbable that the tubercles were much more pointed, as they are represented in our figure.

The last whorl is sharply angulated at its periphery and rugose; the basis is flattened and spirally striated, very slightly impressed in the middle; the aperture quadrangular with the columella solid and distinctly twisted;* the outer lip must have been deeply insinuated at the basis, especially towards the periphery, as can be seen from the direction of the striæ of growth.

Locality.—Comarapolliam, in whitish sandstone; very rare.

Formation.—Arrialoor group.

XC. ZIZIPHINUS, *Gray*, 1840.

1. Ziziphinus (Eutrochus ?) Geinitzianus, *Reuss, sp.*, Pl. XXIV, Figs. 11-15.

1840. *Trochus granulatus*, Geinitz, Char., p. 46, Pl. XV, Fig. 20 (non *idem*, Roemer, 1839).
1846. „ *Geinitzianus*, Reuss, Böhm. Kreidef., pt. II, p. 112, pl. XLIV, Fig. 24.
1846. „ *Arcotensis*, Forbes, Trans. Geol. Soc., London, VII, p. 119, Pl. XIII, Fig. 9.
1847. „ *Jason*, d'Orbigny, Voyage Astrolabe, Paléont., Pl. IV, Figs. 12-14.
1847. *Solarium deperditum*, d'Orbigny, *ibidem*, Figs. 9-11.

Ziziph. testa plus minusve depresso-conica, anfractibus 5-7, *planis seu convexiusculis, antice prope suturam carinatis,* 4-7 *striis spiralibus spinulose granulosis ornatis, sæpissime etiam striis obliquis transversalibus notatis, ultimo ad peripheriam semper carinato; basi applanata seu subconvexa, spiraliter granulose striata, funiculate umbilicata; apertura subquadrata, labro tenui, ad peripheriam acute angulato, labio crassiusculo, regionem umbilicalem sæpe tegente, antice obtuse terminanti.*

Spiral angle 75°-95°; sutural angle 7°-10°.			
Height of shell : its diameter ...	(considered as 1·00) ...	...	1·20—1·35.
„ „ one whorl : its width ...	(„ „ „) ...	...	0·30—0·40.

The broadly conical form and the ornamentation are very characteristic of this species. When the surface of the shell is well preserved, the spiral striæ, being generally four or five in number, as well as the transverse ones, are very distinct and form in crossing each other small spinose tuberculations. The most anterior of the striæ is always stronger than the rest, forming especially on the periphery of the last volution a distinct keel; posteriorly all the whorls are narrowly flattened. In specimens which have the surface of the shell somewhat worn off, the tubercles become more rounded and isolated (Fig. 12), or the transverse striæ occasionally become stronger (Fig. 13) so as to form ribs; and again when the external layer of the shell is wholly taken off, the ornamentation is reduced to a few spiral and transverse striæ, or it disappears altogether. Connected with the changes of ornamentation, which I believe are principally due to the state of preservation of the shell, the originally flat whorls become more or less convex, and then the total appearance of the shell is rather subglobose.

The basis of the perfect shell is somewhat convex and covered with spiral granulated striæ; in imperfect specimens it is more flattened and only spirally striated; the aperture is sub-quadrangular, the inner lip being straight, somewhat

* Not well shown in our figure.

thickened, and anteriorly terminating obtusely, in the perfect shell often nearly covering the umbilical opening.

Dr. A. Fritsch showed me at Prague several well preserved specimens of this species from the Bohemian cretaceous deposits from which it was originally described, and as the publication of Reuss' name is somewhat prior to that of Forbes it ought to be retained, though neither of the figures of Geinitz, Reuss or Forbes are very characteristic. D'Orbigny's figure of *Tr. Jason* is taken from an imperfect, small specimen without shell surface, it in fact only represents the top of the shell. The original specimen of *Solarium deperditum*, in the collections of the Jardin des Plantes, is likewise not referrible to any other species; it has the ornamentation not so well preserved as represented in d'Orbigny's figure.

Geinitz (Quadersandsteingebirge, 1849-1850, p. 130) identifies *Tr. Rozeti*, d'Archiac (Mém. Soc. Géol., France, 2me. ser., II, pt. II, p. 336, pl. 22, fig. 11) from the Tourtia of Tournay with the present species. I have not been able to see the originals, but on comparing the respective figures with ours it will be seen that the Indian fossil has a somewhat larger spiral angle than the Belgian one. The same is, however, the case with Reuss' original figure, and to some extent even with that of Geinitz; still having compared a large number of specimens at Prague and at Dresden, I am confident that there does not exist any specific distinction between them. It is not only possible that the above-mentioned *Tr. Rozeti* may be proved to be identical with our shell, but the same is likely to be the case with *Tr. Cordieri*, *Tr. Buneli* and *Tr. Huoti* of the same author, and from the same deposits *(ibid.* p. 335, pl. 22, figs. 8, 9, 10).

Geinitz quotes the species from the Hippuritic limestone of Bohemia and the Plæner limestone of Saxony; both are about equivalent to our Upper Greensand. The species was probably living on coral reefs, like many of the recent *Ziziphinus;* it belongs to the section which includes the few umbilicated species and for some of which Adams proposed the name *Eutrochus.*

Localities.—Comarapolliam, Arrialoor, Olapaudy, between Andoor and Veraghoor, in light coloured sandstone; near Garudamungalum, in bluish sandstone.

Formation.—Trichinopoly- and Arrialoor- groups.

XCI. CANTHARIDUS, *Montfort*, 1810.

1. Cantharidus striolatus, *Stoliczka*, Pl. XXIV, Fig. 1.

Canth. testa ovato-conica, apice obtusiusculo; anfractibus circiter senis, subconvexis, postice ad suturam paulo constrictis, spiraliter minute striatis, ultimo ad peripheriam rotundate-angulato; basi convexiuscula; apertura subquadrata, labio fere recto, columella solida, antice truncate-terminanti, labro tenui.

Spiral angle about 55°; sutural angle about 10°.
Height of shell : diameter of its basis (considered as 1·00) ... ... 1·42.
„ of one whorl : its width ... („ „ „) ... ... 0·54.

A small subovate shell, composed of about six volutions, which are slightly convex, and somewhat obtuse at the apex; the last is angularly rounded at the

periphery and convex at the basis, being slightly impressed in the middle; aperture subquadrate, outer lip thin, anteriorly sinuous, inner lip nearly straight, columella solid, terminating with a slight point. The entire surface of the shell is covered with fine spiral striæ, by which only it is distinguished from *Turbo Raulini*, d'Archiac (Mém. Soc. Géol., France, 2nd ser., vol. II, p. 341, pl. 23, fig. 12), from the Tourtia beds of Tournay in Belgium, both these species being in every other respect almost identical.

The recent species of *Cantharidus* are not usually striated; when, however, the superficial, polished surface of the shell is a little eroded, the striation becomes perceptible.

Locality.—Comarapolliam, in whitish sandstone; very rare.

Formation.—Arrialoor group.

XCII. SOLARIELLA, *S. Wood*, 1842.

1. Solariella radiatula, *Forbes*, sp., Pl. XXIV, Figs. 17-19; Pl. XXVIII, Figs. 8-9.

1846. *Trochus radiatulus*, Forbes, Trans. Geol. Soc., Lond., VII, p. 120, Pl. XIII, Fig. 11.
1847. *Trochus castor*, d'Orbigny, Paléontologie d'Astrolabe, Pl. IV, Figs. 15-17.
1851. *Turbo glaber*, Müller, Petref. Aach. Kreidef., pt. II, p. 43, Pl. V, Fig. 6.

Sol. testa conica, subturrita; anfractibus 7-8, *convexiusculis, sutura simplici junctis, junioribus spiraliter multi-striatis atque striis incrementi transversalibus notatis, adultis fere levigatis; ultimo ad peripheriam rotundato, ad basin sub-convexo, umbilicato; apertura quadrangulari, antice in margine umbilici emarginata; labio tenui, postice angulato, labro simpliciter arcuato; margine umbilici crenato.*

Spiral angle 60°-80°; sutural angle 12°.		
Height of shell : diameter of its basis (considered as 1·00)	...	1·15—1·00.
„ of one whorl : its width ... („ „ „)	...	0·40—0·35.

Shell more or less broadly conical, composed of about seven or eight convex volutions, which are separated by an impressed, simple suture. Young specimens have the whorls very narrowly and numerously spirally striated, and besides covered with thin, transverse ribbings, which are more distinct posteriorly than anteriorly; older grown specimens often become nearly smooth, and their suture occasionally slightly canaliculated (see Fig. 17, Pl. XXIV); some of the spiral posterior striæ at the suture occasionally are stronger than others. The last whorl is rounded at the periphery, somewhat flattened at the base and umbilicated, the umbilicus having a distinctly crenulated edge. The aperture is quadrangular, with thin margins, the inner lip forms posteriorly an angle from which a slight rib runs upwards in the internal space of the umbilicus.

Forbes' figure is somewhat deficient, and that of d'Orbigny is taken from a small, but not well preserved specimen. Müller's figure represents some of the broad varieties, and the characters of the species are well pointed out in the author's description. I had an opportunity of examining all the original specimens in London, Paris and Aix-la-Chapelle and ascertaining their identity.

D'Archiac's figure of *Turbo Walferdini* from the Tourtia of Tournay (Mém. Soc. Géol., France, 1847, 2nd ser., vol. II, p. 341, pl. 24, fig. 6) reminds one very much of the characteristic form of *Sol. radiatula*, but the author says that the umbilicus is covered with a large callosity, which, of course, would refer this shell to another family altogether, being probably allied to the genus *Chrysostoma* of the *Umboniidæ*.

Localities.—Vylapaudy, Olapaudy, Comarapolliam, Arrialoor, etc. (Arrial. gp.); Andoor and Kolakonuttom (Trich. gp.); south of Puravoy, Moraviatoor, Odium, (Oot. gp).

The beds of Aix-la-Chapelle, where the species is not uncommon, are considered as equivalents of d'Orbigny's Senonien.

Formations.—Arrialoor –, Trichinopoly –, and Ootatoor – groups.

The species may be considered characteristic only of the first named group, as it appears to be rather a rare shell in the two others. The numerical proportions of the specimens represented in our collection from different localities of the three named groups are 200—25—4 respectively.

2. Solariella strangulata, *Stoliczka*, Pl. XXIV, Fig. 20; Pl. XXVIII, Fig. 10.

Sol. testa conica, subturrita, anfractibus circiter senis, convexis, spiraliter dense striatis, postice ad suturam jugo rugoso instructis, deinde anguste-canaliculatis atque rursus una vel duabus striis fortioribus notatis; striis transversalibus minutis; basi convexa, umbilicata, margine umbilici crasso, subtuberculato; apertura subrotundata, antice in margine umbilici emarginata, labio atque labro intus levissimis, crassiusculis, ad marginem acutis.

Spiral angle 70°; sutural angle 12°-13°.				
Height of shell	:	diameter of its basis (considered as 1·00)	... ...	1·14.
„ „ one whorl	:	its width („ „ „)	... ...	0·37.

This species very closely resembles the previous one, but can be readily distinguished by a strongly thickened and rugose posterior margin of the whorls, having in front a narrow, but deep channel, to which follow one or two rather strong spiral striæ. To exhibit the differences of the two species more clearly we have given an enlarged view of a portion of the whorls of each on Pl. XXVIII, Figs. 8, 9 and 10.

The number of whorls appears to be also somewhat smaller in the present species, than in the former. The surface is finely spirally striated; the edge of the umbilicus very thick and subtuberculated, internally slightly granulated. The internal pearly structure of the shell is distinctly traceable in two of our specimens.

Locality.—Near Odium, in a brown and blackish calcareous sandstone; rare, only three specimens having as yet been found.

Formation.—Ootatoor group.

XCIII. MARGARITA, *Leach*, 1819.

1. Margarita orbiculata, *Stoliczka*, Pl. XXIV, Fig. 16.

Marg. testa orbiculata, tenui, late conica, apice sub-acuminato; anfractibus postice anguste applanatis, subconvexis, sublevigatis, transversaliter minute striolatis, ultimo ad peripheriam angulato, ad basin convexiusculo, late umbilicato; apertura quadrangulari.

Spiral angle 100° ; sutural angle 8°.
Height of shell : diameter of its basis (considered as 1·00) ... ... 0·75.

The whorls of this species are posteriorly narrowly flattened, slightly convex, and only marked with transverse striæ of growth; the last is angular at the periphery, and broadly umbilicated at the basis, the edge of which is not crenulated, though the transverse striæ are particularly distinct on this portion of the shell, being thin as usual in recent species belonging to this genus. The aperture is quadrangular, but its margin is not perfect in our specimens.

Localities.—Near Andoor, in whitish, and near Garudamungalum, in bluish sandstone; very rare.

Formation.—Trichinopoly group.

XCIV. DELPHINULA, *Lamarck*, 1803.

1. Delphinula annularis, *Stoliczka*, Pl. XXV, Fig. 3.

Delph. testa orbiculato-conica, crassa, spira subturrite-elevata; anfractibus postice applanatis, lente-convexis, spiraliter quadri-jugosis, transversaliter striolatis, ultimo convexo, extus 7-8 *jugis spiralibus, distantibus ornatis; basi late umbilicata; apertura subrotundata, marginibus paulo expansis, attenuatis instructa.*

Spiral angle about 110°.
Approximate height of the shell : diameter of its basis (considered as 1·00) ... 0·83.

The shell is composed of about four volutions, which are posteriorly broadly flattened, and on the sides slightly convex and ornamented with four spiral, sharp ridges, two of them being placed nearer to the upper angle and two nearer to the anterior suture. The last whorl is convex on the periphery, and on the basis ornamented with about seven or eight similar ridges, which are rather distantly placed from each other. The entire surface of the shell is besides covered with very numerous, thin, transverse striæ. The spiral ridges are wanting on the posterior flat portion of the whorls. The umbilicus is largely opened, with a very sharp rib near its edge. The aperture is rounded and only attached to the previous volution by a very narrow inner lip; its margins were somewhat expanded, as may be observed on several complete casts in our collection.

This shell is very distinct from any other cretaceous form known, and it is a true *Delphinula*, being allied to several recent species, as *D. laciniata*, Lam., *D. tyria*, Reeve, and others from the Eastern seas.

Locality.—W. and N. of Odium, in brownish sandstones; not very rare.

Formation.—Ootatoor group.

2. ? Delphinula rotelloides, *Forbes, sp.* Pl. XXVIII, Fig. 13.

1846. *Trochus rotelloides*, Forbes, Trans. Geol. Soc., Lond., VII, p. 120, Pl. XIII, Fig. 10.
1850. *Turbo id.* d'Orbigny, Prod. II, p. 224; *idem* auctorum.

[*T. testa depressissima, spiraliter striata, anfractibus superioribus planis, ultimo compresso, rotundato; basi umbilicata, spiraliter striata*], Forbes, *loc. cit.*

Forbes' figure, which we reproduce with a slight alteration, gives only a general idea of the characters of the species. The original specimen is very imperfect; it may be a *Delphinula*, though it is not unlike imperfect specimens of *Ninella* or *Marmarostoma*.

In Fig. 10*a* Prof. Forbes represents a few stronger spiral striæ, which give the shell an appearance of a *Pleurotomaria*, but there is no distinct band traceable on the original specimen. The striæ of growth are continuous from the suture to the middle of the last whorls, on the basis of which they appear to be much thinner. Along the posterior margin the whorls are provided with a slight swelling, below which there is a narrow flat portion marked with somewhat finer spiral striæ, than on the rest of the shell.

Locality.—Pondicherry, in light bluish calcareous sandstone.

Formation.—? Arrialoor group.

LIV. *Family,—STOMATIIDÆ.*

Gray, Cat. 1857, p. 158; H. and A. Adams, Gen. I, *stomatellinæ*, p. 435.

Animal depressed, with a largely developed, fleshy foot; head distinct, rostrum thick, produced, tentacles long and thin, eye-peduncles short and thick, two frontal lobes between the tentacles; upper part of the foot surrounded by a fringe consisting of numerous short, uniform filaments, mantle entire; branchial plume single, with two rows of thin strands; teeth similar to other Scutibranchiata. According to the figure (19, pl. 66 bis, in Zool. Voy. Astrol.) of Quoy and Gaimard the central teeth appear to be wanting, the inner lateral are three on each side, thick and simply hooked, the outer lateral are numerous and uniform; other forms distinctly show a central tooth and a large number of inner lateral which are always stronger, than the inner ones.

Operculum thin, horny, few whorled, occasionally wanting.

Shell depressed, consisting of few rapidly increasing whorls, spire very short, often quite indistinct; aperture entire, very wide, pearly within.

According to Gray, the family consists of five genera. H. and A. Adams also place in it *Scissurella (Anatomus)*, which more properly belongs to the *Pleurotomariidæ*. In his last Catalogue (Mrs. Gray's figures of Moll., 1859, vol. IV, p. 90) Gray distinguishes only two genera, *Stomatella* and *Gena*, to which *Broderipia* certainly ought to be added, but this tri-division of the family is probably all that is at present required, or rather that can without great difficulty and uncertainty be carried out with respect to generic distinction. As I am, however, not acquainted

with any of the animals and only very few shells of the *Stomatiidæ*, and as the study of the fossil forms is not directly opposed to the usually accepted sub-divisions, I shall quote the genera from H. and A. Adams' and Gray's previous publications.

1. *Stomatia*, Helbling, 1778 (H. and A. Adams, Gen. I, p. 436). Shell oblong, suborbicular, with a short prominent spire, whorls plicated at the suture, carinated or tubercular; aperture laterally and anteriorly very much produced.

2. *Stomatella*, Lamarck, 1809 (*ibid.* p. 435) has a similar shell, but the aperture is laterally less produced, the spire usually higher, the whorls spirally ribbed or striated, and the internal pearly layer much thinner than in *Stomatia*.

3. *Microtis*, Adams, 1850 (*ibid.* p. 437), has two tuberculated ridges above near the periphery of the last whorl, the inner lip somewhat twisted. The animal has a deep fissure in front of the foot. The shell, say H. and A. Adams, resembles a little *Haliotis* without the perforations.

4. *Gena*, Gray, 1842 (*ibid.* p. 437). Shell sub-spiral, oblong, ear-shaped, spire very short or indistinct.

5. *Niphonia*, Adams, 1860 (Ann. mag. nat. hist., VI, p. 336). Shell like *Stomatella*, but very thin, columellar lip internally thickened and gradually passing into the outer one.

6. *Broderipia*, Gray, 1847 (H. and A. Adams, Gen. I, p. 438). Shell cup-shaped, like a *Helcion*, smooth, or more usually covered with very fine spiral and radiating striæ, internally distinctly pearly.

Fossil species of the *Stomatiidæ* occur already in palæozoic formations, and continue in small numbers to be found through all the mesozoic and tertiary deposits. The recent species are chiefly inhabitants of the eastern seas; they are found mostly on coral reefs at moderate depth, and some of them at low water under stones.

There have been four cretaceous species described under the name of *Stomatia*; the first by d'Orbigny (Pal. franç. terr. crét. II, p. 237, pl. 188, figs. 4-7) as *St. aspera*, which, I rather think, is a *Sigaretus*; *Stomatia gaultina*, Pictet and Roux (Moll. Grès verts, p. 245, pl. 24, fig. 3) has the general form of a *Stomatella*, but it is as yet only known from a cast; *Stomatia ornatissima*, Coquand (Étage Aptien de l'Espagne, 1865, p. 74, pl. 5, figs. 4-5) is more likely an *Astralium*; *Stomatia bicarinata*, Guéranger (Album pal. de la Sarthe, 1867, pl. 10, fig. 8. *Sigaretus? id.* olim.) is to all appearance a true *Stomatia*. I have nothing to add from South India.

V. *Sub-order*,—Fissobranchiata.

The animals possess, as far as known, a thick fleshy foot, usually having on the upper part a fringe consisting of numerous, short and uniform cilia, rarely are there two or three pairs of long lateral appendages present; the head is distinct, with thicker or thinner, but always elongated, tentacles, having the eyes on more or less thickened peduncles on their outer side and a complete, or divided and denticulated veil between each other; rostrum usually produced; the teeth resemble those of the Scutibranchiata in general (Rhipidoglossa of Troschel, Lovén

and others), the centrals and inner laterals being large and unequal, the outer laterals small, numerous and equally formed; the mantle is fissured in front, and there always are two equal, or sub-equal, branchial plumes present.

Operculum generally wanting, rarely present, horny.

Shell either spiral, conically elevated or depressed, with a number of perforations or a slit in the outer margin of the aperture, or cupshaped with a peripherical slit, or with a lateral or apical perforation; internally pearly or porcellanous.

I include in this sub-order all the genera which have a slit or an opening in front of the mantle and two symmetrical, or very nearly equal, branchial plumes, thus essentially differing from the SCUTIBRANCHIATA. The shell is extremely variable in form, but with regard to the principal types, three families can be distinguished —

LV.—*PLEUROTOMARIIDÆ.*
LVI.—*HALIOTIDÆ.*
LVII.—*FISSURELLIDÆ.*

These may again be separated into two divisions, one including the two first named families, possessing a spiral, internally generally nacreous shell, with a slit or a number of perforations in the outer lip, and the other only the last named one, having a cup-shaped, perforated or emarginated but not nacreous shell. To the two former the name SCHISMATOBRANCHIA was applied by Gray, while for the last one that of DICRANOBRANCHIA was introduced. I think, however, that the relations as existing between the two tribes warrant their classification in one sub-order to which I have applied the name FISSOBRANCHIATA, the separation of the gills into two more or less equilateral plumes being their characteristic distinction from the SCUTIBRANCHIATA; Gray's two sub-orders will, therefore, be retained as tribes.

I. *Tribe*,—Schismatobranchiata.

Gray, Guide, 1857, p. 160.

The animals have a distinct slit in the front part of the mantle, the two plumes are sub-equal, and placed on the left side of the gill cavity; the eyes are placed on thick bulgings on the outer side of the tentacles.

Shell spiral, conically elevated, with a proportionate aperture, or depressed, with a very large one.

LV. *Family*,—*PLEUROTOMARIIDÆ.*

Of the very large number of genera belonging to this family the animal is only known of *Scissurella (or Anatomus)*, it being closely allied to that of some *TROCHIDÆ*. The foot is narrow, elongated, in front with two short lappets, posteriorly with two pairs of very long serrated cilia; tentacles two, very long and serrated, having the eyes at their base; mantle-slit in front distinct; gills consisting of two plumes; teeth— ? The operculum is very thin, ovate (or circular ?) with an obscure,

subspiral nucleus. Judging from the very great similarity (if not generic identity?) of the shells of *Scissurella* and *Pleurotomaria*, it appears very probable that the animals were also similarly formed.

The shells of the Pleurotomariidæ *are more or less conically elevated, turreted or trochiform, with a slit or a number of perforations in the outer lip.*

The recent *Scisurellæ* are said not to possess an internal pearly layer, but the recent *Pleurotomaria Adansoniana* and some of the fossil species (as for instance those from the Russian jurassic deposits near Moskau) appear to be pearly within. It seems to me that the pearly layer of the minute *Scissurellæ* is only very thin, so as to be hardly noticed in the transparent shells. I am sorry that I have no fresh specimens to examine. The genera which appear to constitute this family, as known at present, are the following:—

1. *Murchisonia*, d'Arch. et de Verneuil, 1841. Shell turreted, aperture ovate, entire in front, outer lip with a short slit, being in connection with a distinct band, traceable on all the whorls. The species are all palæozoic and offer a great variety in form. An internal pearly structure has not been observed.

2. *Forskalia*, H. and A. Adams, 1855 (Gen. I, p. 432). Shell turbinate or subconic, plicated at the sutures, along the anterior of which a narrow band exists, outer lip with a very short emargination. The type of this genus is *Forsk. fanula*, Gmel. H. and A. Adams place it as a sub-genus of *Gibbula;* but judging from the analogy in the form of the shell, the genus must be placed in the *Pleurotomariidæ*, and I think Ryckholt is quite correct in stating that the *Trochus fanulus (Forskalia id.)* is quite as closely allied to *Pleurotomaria*, as is *Subemarginula* to *Emarginula* (*vide* Journ. de Conch., 1860, IV, p. 184). There are indeed a number of palæozoic species, like *Pl. contraria*, *Pl. Galeottiana*, *Pl. inflata*, and others of Koninck, and of mesozoic species like *Pl. monilifera*, d'Orb., which can with great difficulty be distinguished from the recent *Forskalia*.

3. *Porcellia*, Leveillé, 1835. Shell symmetrically discoid, with a narrow band on or near the centre line of the back, corresponding with a slit on the outer lip of the aperture. The species are palæozoic and lower secondary. Hörnes properly remarks that the genus can be retained only for the symmetrically discoid forms, for it cannot be questioned that some of the jurassic subdiscoid *Pleurotomariæ* (like the *Pl. mirabilis*, Desl. and *Pl. platyspira*, d'Orb., from Normandy) are very closely allied in form, but they are always distinguished by a broader band which is not quite centrally placed.

4. *Pleurotomaria*, Defr., 1821; shell broadly conical, pearly within, slit in the outer lip moderately deep, band rather broad, inner lip of the aperture slightly thickened, columella solid or hollow. Species of *Pleurotomaria* occur through all the sedimentary deposits from the Silurian upwards. Tertiary species are very rare, and only two, *Pl. Quoyana* and *Adansoniana*, have been found recent.

I fully agree in the statement of Eugène Deslongchamps that a generic (or sub-generic as it may be called) sub-division of the species usually determined as *Pleurotomaria* is very desirable (Bull. Soc. Linnê. Norm., 1865, vol. IX, p. 422).

The variety in the form of the shell of the palæozoic* and the secondary* species is indeed almost greater than it is to be met with in the *Trochidæ*. The only great difficulty which accompanies a more detailed distinction of the *Pleurotomariæ* is the rarity of the outer lip being perfectly preserved; it would be, therefore, in many instances perfectly useless to propose any generic distinctions upon imperfect specimens. The general form of the shell, the ornamentation, position of the band on the whorls, and the form of the slit in the outer lip are the principal characters upon which further generic distinctions have to be made.

5. *Ptychomphalus*, Agass., 1837 (Min. Conch., Ger. edit., pp. 23, 222, etc. *Cryptænia*, Desl., 1865, Bull. Soc. Linn. Norm. IX, p. 424).

Agassiz proposed the name for two species described by Sowerby (Min. Conch. II, pp. 159-160, pl. 171) as *Helix? striatus* and *cirriformis*, being helicior trochi-form shells, with an almost smooth surface, a thick callosity covering the umbilical region and a distinct band on the posterior portion of the whorls, terminating at the aperture with a short slit. Both the original species are palæozoic, in which period this genus is very largely represented, being by its smooth surface and the umbilical callosity readily distinguished from other *Pleurotomariæ*. Some naturalists have referred these species to *Umbonium* (= *Rotella*); others to *Pleurotomaria*, pointing, however, to the remarkable distinctions between them and typical species of that genus. Eug. Deslongchamps lately proposed for these forms the name *Cryptænia*, quoting the liassic *Pl. heliciformis* as the type of the genus. Of cretaceous species I only know *Pl. anomala*, Pictet and Camp., which belongs to *Ptychomphalus*; of jurassic species there are about ten, and of palæozoic about thirty, known.

6. *Leptomaria*, Desl., 1865 (Bull. Soc. Linn. Norm. IX., p. 423). Shell subturbinate, rather thin, generally ornamented with very numerous subequal spiral striæ, band very narrow placed near the middle of the whorls, slit in the outer lip very deep, axis solid or hollowed out. This is a very well marked group of *Pleurotomariidæ*, deserving of generic distinction. The species are, as pointed out by Eug. Deslongchamps, hardly found in the palæozoic and lower secondary formations, the first typical forms being met with in the lower beds of the Dogger. About one-half of all the cretaceous *Pleurotomariæ* belong to this genus, though the actual number of the species is most probably not so large as represented by the numbers in Catalogues, many of the so called species being only varieties of others. Great mischief is occasionally done by the application of specific names to various casts, whenever they are observed to exhibit a slight difference in the shape of the whorls. Such distinctions must be, however, applied with extreme caution, as the shape of the whorls in all *Pleurotomariidæ* is very variable. This is pre-eminently the case in *Leptomaria*. I may also here mention that there are often species of this genus met with in which irregularities in the growth of the band occur. I have described such a species from the alpine

* See Palæozoic foss. of Phillips, McCoy, Carb. fossils of Koninck, Sandberger's Schichtensystem der Rheinlande, d'Orbigny's Pal. française, etc.

Lias under the name of *Trochotoma* (Sitz. Akad., Wien, 1861, XLIII, p. 193), but I rather believe now that those anomalies are most probably due to accidental injuries of the slit, and are in any case not constant. The tertiary *Pl. Sismondai*, Goldf. (Petref. Germ. III, pl. 188, fig. 1), from Bünde is a *Leptomaria* and probably also the two species described from the tertiaries of Italy. *Pl. concava*, Desh., from the Paris basin appears to represent a new type, for although it has a very narrow and deep slit, its form, ornamentation and the character of the margins of the aperture are very different.

The two recent species are in form allied to *Leptomaria*, but they have a much wider band and a short slit and consequently belong to *Pleurotomaria* proper.

7. *Scissurella*, d'Orb., 1823 (*Scissurellidæ*, Gray; Deshayes, Anim. s. vert. foss. bass. de Paris, 1866, III, pp. 1-7; *Anatomus*, Montf., H. and A. Adams, Gen. I, p. 439, and others). Shell orbicular or depressedly conical, thin, widely umbilicated, internally not (?) pearly, outer lip with a short slit continuing as a band on all the previous whorls, inner lip of the aperture thin, outer lip at the base broadly insinuated. Setting aside the size of the shell it must be agreed that some of the widely umbilicated species of *Pleurotomaria* are externally not to be distinguished from *Scissurella*, and have most probably to be referred to this genus, for I do not think that the nacreous internal layer of the shell of *Scissurella* is perfectly wanting. The typical *Pleurotomariæ* always have the inner lip somewhat thickened, while those of *Leptomaria* have it thinner and, like the narrow band, more similarly formed to that of *Scissurella*.

With reference to Montfort's name *Anatomus*, Deshayes' latest arguments must be considered as conclusive, namely, that Montfort could not have described a shell of *Scissurella;* and as that author's reference to the figures in Soldani's work do not apply to *Scissurella* (which has been figured in the same work) but to *Spirorbis* (perhaps *Cryptobia* of the *Siliquariidæ*) the name *Anatomus* must not be used in place of that of *Scissurella*.

There are at present about 26 recent and some six or seven tertiary species known; the mesozoic ones have as yet to be discriminated.

8. *Polytremaria*, d'Orb., 1850 (Prodrome, I, p. 122), proposed for the carboniferous species *P. catenata*, Kon., being a trochi-form shell with the band composed of numerous small perforations, somewhat like in *Haliotis*.

9. *Trochotremaria*, Ryckholt, 1860 (Journ. Conch., IV, p. 186), is said to be a turbinate shell with an obliterate band, showing a number of round perforations; two or three of these being always open; the species are carboniferous.

10. *Catontostoma*, Sandberger, 1842. The only species as yet known is *Cat. clathratum* from the palæozoic (devonian or carboniferous?) rocks of the Rheinlande. According to Suess who was the first to give a correct characteristic of the species the shell is ovate, rather solid, composed of numerous convex volutions, the last of which is towards the aperture deflexed, this being oval, with the margins united, having the inner and outer lips almost parallel; a distinct band

is traceable about the middle of the whorls, having on the last whorl at the place where this one is deflected an elongated, kidney-shaped perforation surrounded by somewhat thickened margins; another small perforation is found about the centre of the basis, but in the outer lip, it is likewise surrounded with a raised margin.

Prof. Suess very correctly compared the first perforation on the band with that of *Trochotoma*, or rather that of *Ditremaria*, as emended according to the last researches of Deslongchamps. The second perforation near the centre of the base is indeed very peculiar, and we have actually nothing analogous to it except the basal perforations of *Triphoris*, and, as I believe, that of *Exelissa* (see p. 189). M. de Ryckholt was evidently not acquainted with Prof. Suess' detailed description of *C. clathratum*, when he stated that the genus is identical with *Pleurotomaria* (Journ. d. Conch., 1860, IV, p. 183).

11. *Ditremaria*, d'Orb., 1843. Eug. Deslongchamps in a recent paper (Bull. Soc. Linn. Norm., 1865, IX, p. 427) again introduces d'Orbigny's name for two well known jurassic species, *D. globulus*, Desl., and *D. quinquecincta*, Ziet., of both of which he had examined well preserved specimens.

These shells somewhat resemble in the ovately conical form and the solid structure *Catontostoma;* the band has near the margin of the outer lip one long kidney-shaped perforation, being very much contracted in the middle; the centre of the base is provided with a strong callosity, which usually terminates at the inner lip with a prominent tooth.

12. *Trochotoma*, Desl., 1841, has the base funnel-shaped, excavated, usually without a strong callosity; the band has one elongated perforation near the margin of the outer lip. In the paper quoted above Eug. Deslongchamps pointed out the distinctions which exist between this and the last named genus, the species of which are chiefly known from jurassic deposits. Specimens of intermediate growth often have a perforation and a short slit (see Bull. Soc. Linn. Norm., 1865, IX, pl. 3, fig. 4).

13. *Shismope*, Jeffreys, 1856 (Ann. mag. nat. hist., p. 319—*Woodwardia*,* Crosse and Fisch., 1861, Journ. d. Conch., IX, p. 160), a name used for the recent species of *Trochotoma*, which agree in their small size with *Scissurella*, but differ from it by the presence of a single elongated perforation. A. Adams (Ann. mag. nat. hist., 1862, X, p. 346, etc.) described three recent species from the Japan and China seas, but he applies to them the name *Scissurella*, and calls the typical forms of this genus, distinguished by a slit of the outer lip, *Anatomus*, Montf. I have already remarked that this last name of Montfort is inadmissible.

It must be granted that these recent species do not, as regards form, differ from the fossil ones of *Trochotoma*, but the former are said to have the internal layer of the shell not pearly, while the latter are supposed to be pearly within. If this be in reality the case, as suggested by Crosse (Journ. Conch., 1865, V,

* This name has been formerly used by different authors and cannot be used again, even had it priority as compared with *Shismope*.

p. 239) and supported by Eug. Deslongchamps, the distinctions between *Shismope* and *Trochotoma* may hold good, but in the contrary case Deshayes' suggestions of their identity must be accepted (see Journ. Conch., 1865, p. 230, etc.; *Trochotoma Terquemi* from the tertiary sand near Bordeaux).

The genus *Cirrus*, Sow., as introduced by D'Orbigny, and other allied forms for which new generic names have been proposed by Ryckholt, will be mentioned in the next family.

With reference to the number of cretaceous *Pleurotomariidæ* I must direct the reader to the Catalogue in Pictet and Campiche's Pal. Suisse, 3me. Ser. A few species have been subsequently described by Coquand in his work on the fossils of the province Constantine and of the 'Aptien' of Spain, and a few other works. From our South Indian cretaceous deposits I have to report two species of *Pleurotomaria* (*Pl. loricatula* and *glabella*, n. sp.) and one of *Leptomaria*, (*Lept. indica*, Forb.).

XCV. PLEUROTOMARIA, *Defrance*, 1821.

1. Pleurotomaria loricatula, *Stoliczka*, Pl. XXV, Fig. 4.

Pleu. testa ovato-conoidea; anfractibus circiter septenis, subconvexis, fascia angusta supra medium sita divisis, supra fasciam spiraliter striis ternis, acutis, infra senis similibus, (tribus anticis tenuioribus), transversaliter supra atque infra fasciam costulis numerosis acutis ornatis; basi subconvexa, angustissime umbilicata, spiraliter striata; apertura subquadrangulari, labio crassiusculo, levi, labro ad basin paulo producto, lateraliter inciso, fissura quartam unius circuitus partem occupante.

Spiral angle 58°; sutural angle about 6°.
Height of shell : diameter of its basis (considered as 1·00) ... ... 1·14.
„ of one whorl : its width ... („ „ „) ... ... 0·40.

The slightly convex whorls possess a very characteristic ornamentation, the upper portion having three and the lower six spiral striæ; of the latter the three most anterior are thinner and closer to each other than the rest. Numerous sharp transverse ribs cross each whorl, being interrupted at the band, which is narrow and placed above the middle. The last whorl is roundish at the periphery, the basis slightly convex and spirally striated; umbilicus very narrow and almost covered by the thickened and straight inner lip. The aperture is quadrangular, the outer lip being at the base only slightly expanded, and the lateral fissure extending from the margin to about one-fourth of a circuit of a whorl.

The only allied species is *Pl. falcata*, d'Orb. (Pal. franç. crét. II, pl. 200, figs. 9-12) from the chloritic chalk, but is readily distinguished by the larger number of spiral striæ and stronger transverse ribs.

Locality.—N. E. of Odium, in brownish, calcareous sandstone; apparently very rare.

Formation.—Ootatoor group.

2. Pleurotomaria glabella, *Stoliczka*, Pl. XXV, Figs. 8 and 9.

Pleu. testa conica; anfractibus applanatis, sublevigatis, postice striis tribus spiralibus notatis, striis incrementi tenuibus, fascia lata, convexim prominente; ultimo anfractu ad peripheriam angulato; basi subplana, spiraliter striata, in medio impressa, haud umbilicata; apertura quadrangulari, obliqua.

Spiral angle 58°; sutural angle 7°.
Height of shell : diameter of its basis (considered as 1·00) ... ... 1·00.
„ of one whorl : its width ... („ „ „) ... ... 0·33.

This species rather represents a jurassic type of *Pleurotomaria*, having a regular conical form, almost smooth surface, and a very broad band, situated below the middle of each whorl. The whorls are posteriorly somewhat concave and marked with three subobsolete spiral striæ, the striæ of growth being on the entire surface fine, but distinctly traceable. The basis is rather flat, and also spirally striated; columella solid; aperture subquadrangular, oblique, rather sharply angular at the periphery of the base; the slit of the outer lip appears to be very short. Casts of the shell have the whorls more or less rounded, but their posterior flattening is always traceable.

Locality.—S. of Puravoy, in brownish calcareous sandstone; apparently rare.

Formation.—Ootatoor group.

XCVI. LEPTOMARIA, *Deslongchamps*, 1865.

1. Leptomaria indica, *Forbes*, sp., Pl. XXVI, Figs. 1—4.

Lept. testa conica, spira elevata atque sub-acuminata; anfractibus numerosis, prope medium plus minusve distincte angulatis, aliquantisper subconvexis, spiraliter sulcato-striatis: striis numerosis, fortioribus et tenuioribus sæpius alternantibus, striis incrementi decussantibus, supra sinuose obliquis, infra prope rectis; fascia angustissima, ad angulum medianum sita; ultimo anfractu ad peripheriam angulato, acute seu obtuse carinato; basi subconvexa, in medio funiculate impressa et umbilicata, in adultis speciminibus prope medium et ad peripheriam spiraliter sulcato-striata; apertura quadrangulari.

Spiral angle 70°-105°; sutural angle 5°-8°.
Height of shell : diameter of its basis (considered as 1·00) ... 0·85—1·00.
„ „ one whorl : its width („ „ „) ... 0·52—0·40.
Height of shell of largest specimen ... 95 mm.
Diameter of basis of ditto ... ... 113 mm.

The form of the whorls of this species is extremely variable, as is indicated by the great differences in the spiral angle. Well preserved shells always have the whorls angular near the middle, where the very narrow band is situated, but this angular shape is generally much stronger in specimens with a depressed spire than in those with a more elevated spire. The portion of the whorls above the band is flat or slightly convex, the lower one straight; only when the surface of the shell is worn off do they present a continuous convex outline. In such

imperfectly preserved specimens there are on the upper whorls transverse ridges (see Fig. 2 a.) traceable, which appear to owe their origin to lamellar thickenings, slightly projecting in the internal space of the whorls; they disappear as soon as the shell attains a larger size. The entire surface of the shell is spirally striated, the striæ usually alternating in strength, though none of them are of any considerable thickness. The striæ of growth are much thinner and produce a fine granulation on the former, being clearly perceptible when the surface of the shell is well preserved.

The basis of the last whorl is more or less sharply carinate at the periphery, slightly convex, depressed in the centre, distinctly umbilicated and spirally striated, the striæ being in old specimens more distinct near the umbilicus and at the periphery, than between them. The aperture is quadrangular, rather oblique in well preserved shells, having on the outer lip a deep, very narrow slit.

This species is very closely allied to a large number of cretaceous *Leptomariæ*, like *Lept.* (*Pleur.*) *gigantea*, *striato-granulata*, Goldf., *Lept. Anstedi* apud Pictet and Campiche,* and several others which are extremely variable in form. We are in possession of a large series of the present Indian species from different localities and beds of the Trichinopoly district, but it is impossible to detect in the degree of the angular shape of the whorls, or in the spiral striation, any characters which would indicate a *farther* specific distinction. In most cases the differences in the ornamentation and also in the convexity of the whorls appears to us rather to depend upon the preservation of the shell, than upon anything else. It is always a great mistake to determine species only from their casts, but in the case of this peculiar type of *Pleurotomariidæ*, to which the present species belongs, such determination actually appears to have no value whatever. From all our cast-specimens (about 100) I can hardly find two which are in every detail identical.

There are often specimens met with which on the upper whorls seem to have had portions of the thin shell near the band fractured, and though these places become subsequently restored, they always are traceable from the interruption of the spiral and transverse striæ (see Fig. 2 a).

Localities.—Neighbourhood of Odium and Moraviatoor, in brown calcareous sandstone (Ootat. gp.); Olapaudy, Veraghoor, Comarapolliam, Arrialoor, Mulloor, etc., in light coloured sandstone (Arr. gp.)

Formation.—Ootatoor and Arrialoor groups, more common in the last one.

LVI. *Family,—HALIOTIDÆ.*

According to the observations of Cuvier, Deshayes and others, the animal of *Haliotis* is distinguished by a large foot provided with two lateral fringes, composed of equally formed filaments, resembling those of the *Stomatiidæ*; the muzzle of the head is produced and thick, the tentacles rather long, and usually not

* Mat. Pal. Suisse, IIIme. Ser., pl. 80, fig. 3; this does not appear to be identical with Forbes' *Pl. Anstedi* in Quart. Journ. Geol. Soc., London, 1845, I, p. 349, pl. 13, fig. 1.

very slender, the eyes are placed on thickened, prominent bulgings at their outer base; head lobes are always present, either single or bilobed; the mantle is fissured in front. The dentition in general resembles that of the SCUTIBRANCHIATA, being characterized by a very large number of equally formed, slender, outer laterals; of the inner laterals there generally are on either side five, being much larger than the outer ones; those next to the small central tooth are beamlike, deeply notched on the inside edge, the other four are broadly hooked and pointed. The branchial cavity lies, according to the observations of Cuvier, on the left side of the central adductor muscle; there are two long subequal plumes present.

The shell is ear-shaped, consisting of few, very rapidly increasing, depressed whorls, spire very short, usually flattened; along the inner or left edge of the whorls are placed a number of separated holes, some of which near to the apertural margin are always open for the purpose of supplying water to the branchial cavity, this being apparently accomplished by the vibration of some of the left upper filaments of the fringe projecting through the openings. The aperture is very large, internally pearly, with the inner lip obtuse and more or less flattened.

H. and A. Adams (Gen. I, pp. 440-443) distinguish in this family three genera and one subgenus. Comparing, however, both shells and animals, it must be granted that the distinctions pointed out as existing between the various types are only of minor importance.

1. *Haliotis*, Linn., 1740, has a roundish or ovate shell, being depressed or slightly convex, usually spirally striated and often transversally laminated. The animal usually has a moderately expanded foot. The European *H. tuberculata*, L., may be considered as the type of the genus.

1 *a*. *Teinotis*, H. and A. Adams, 1854, has a very oblong shell, but otherwise not different from that of *Haliotis*. The foot of the animal is very largely, posteriorly produced and provided with a deep, superior longitudinal groove. The type is *H. asinina*, Linné.

4 *b*. *Padollus*, Montf., 1810, is distinguished from *Haliotis* by the presence of a spiral ridge between the suture and the row of perforations. Some species of this section of *Haliotis* have the ridge quite close to the row of perforations; for these the subgeneric name *Sulculus* has been proposed by H. and A. Adams.

Until it can be proved by farther researches that none of the animals of the species, at present referred to *Haliotis*, have above a posterior groove, the distinction of *Teinotis* must be considered only as of subgeneric value, for the form of the shell is, for instance, scarcely much more oval than that of *H. lamellosa*, Lam. Again, comparing some of the transversally ribbed species, like *H. Kamtschatkana*, Jonas, with typical *Padollus*, it will be seen that the line of distinction is extremely difficult, and in some cases almost impossible to draw. The transverse ribs terminate some distance from the suture about the middle of the last whorl, and form here strong tuberculations which, if united, produce the spiral, continuous rib. Other species of *Haliotis*, like *H. papulata*, Reeve, show several stronger ridges, but neither these, nor the transverse ones, are constant.

The *Haliotidæ* are principally inhabitants of the eastern seas, West Africa, the Indian, Australian and Philippine Archipelago. Only very few are found in the Mediterranean and in the Arctic seas.

Fossil species of *Haliotis* are extremely rare; there are only very few known from tertiary deposits, and one from the cretaceous. I can only mention the doubtful *Haliotis* antiqua*, Binkhorst (Mon. Gast. et Ceph. de la craie de Limbourg, 1861, p. 81, pl. 5 a 2, fig. 4), from the Maestricht chalk. The specimen is a small and rather imperfect one, subcircular, the whorls increasing gradually; the spire is raised, the perforations are surrounded with a somewhat raised, rounded margin.

It is usual to find the genus *Cirrus*, Sow., quoted in the neighbourhood of *Haliotis* or of *Pleurotomaria*, and it may be not out of place to give here a short notice of the same. The name *Cirrus* was introduced by Sowerby in 1818 (Min. Conch., II, p. 93, pl. 141), for three palæozoic species, *C. acutus*, *nodosus*, and *plicatus*. All three are turbinate shells, with roundish whorls and a large umbilicus. The first and third I am unable to distinguish from *Straparolus*, except by their having a somewhat more elevated spire. *Cirrus nodosus* has some tubercles on the upper portion of the whorls, but appears to have been only determined from a cast, so that these tubercles represent the remnants of rather prolonged spines on the surface of the shell. It is on account of these spines that d'Orbigny (Prod. I, p. 68) retained the name *Cirrus*. Subsequently in his Pal. franç. terr. jur. II, p. 376, etc.), the same author described two very characteristic species from the liassic beds of Fontaine-Étoupe-four, *Cirrus*† *Normanianus* and *C. calcar*. Both these species are more discoidal than Sowerby's *C. nodosus*, and have the spines very distinct; of these a few, being placed near the aperture, are stated to be open at their terminations.

Now, looking at the interstices between the base of each two spines, we often see the shell somewhat raised, but never forming a distinct band and, therefore, the genus cannot be placed in the *Pleurotomariidæ*, as suggested by several conchologists who have merely taken notice of the general form of the shell. Comparing, on the other hand, the tubes of *Cirrus* with the occasionally tube-like perforations and their interspaces of *Haliotis* they must be admitted to be very similarly formed, especially since these perforations correspond to each other in their position with respect to the form of the whorls. The only important matter to be ascertained is whether the shell of *Cirrus* has an internal pearly layer or not. If it has one, the genus could form a distinct sub-family in the *Haliotidæ*, though I must say I rather doubt the probability of the correctness of this classification. If it be, however, not pearly within, the genus has (and this is more probably correct) to be placed in the *Solariidæ*, next to *Straparolus*. The row of tubes in *Cirrus* is in every way so thoroughly analogous in its formation to the upper tuberculated keels of some characteristic *Straparoli*, that it is most difficult to draw a line of distinction between them.

The only other two genera which I could mention as being related to *Cirrus* are *Onustus* and *Guilfordia*, the last of which is internally pearly; the former not,

* Binkhorst writes *Haleotis*.

† It is not evident for what reason d'Orbigny has here changed the generic name into *Cirrhus*.

but both of them have depressed whorls with the spinal tubes placed at the periphery, not on the upper surface.

II. *Tribe*,—Dicranobranchiata.

Gray, Guide, 1857, p. 162.

The animals belonging to this division, introduced by Gray for the symmetrical forms of the Fissobranchiata, have two equal branchial plumes, placed on the back of the neck, and a *cup-shaped shell*, which only in very young specimens occasionally has a sub-spiral apex. All the genera are united in only one family.

LVII. *Family*,—*FISSURELLIDÆ*.

H. and A. Adams, Gen. I, p. 444; Gray, Guide, 1857, p. 162.

Animal with a thick oval foot, short, broad muzzle, sub-cylindrical tentacles with the eyes sessile on small bulgings at their outer base; the mantle is fissured or perforated in front; there is usually a fringe, composed of a small number of cirri or short filaments, present on the upper part of the foot; the head lobes are sometimes rudimentary, but usually not developed at all; the central tooth is simply incurved, more or less broad, the inner laterals dissimilar, the three or four pairs next to the central one being small, hook-like; one on each side is very large and denticulated, and then follow the numerous outer laterals which are slender, similarly formed, having the tips pointed and incurved. Dr. Williams (Ann. mag. nat. hist., 1865, XVI, p. 419) sometime ago stated that the branchial plumes of *Emarginula* each have only a single row of strands or fillets, while those of *Fissurella* have a double row, one on each side of a central axis. I am not aware whether these observations have been extended to other allied genera; but if these distinctions of the branchial leaves can be traced in other forms, it is just possible that the genera with a slit in the apertural margin can be separated into a distinct family or sub-family from those which have the shell pierced.

Shell cup-shaped, in young specimens sub-spiral at the apex, not pearly within, margin of the aperture with a slit or a slight emargination, generally in front, rarely somewhat on one side, or with a perforation at or near the apex; operculum none.

The *Fissurellidæ* are mostly littoral and phytophagous; they are often found on coral reefs and sparingly on the coasts of all countries; the largest number of species are known from the Indian Archipelago and from South America. Fossil species are not very rare in the tertiaries, but in the mesozoic deposits they rapidly decrease in number, being chiefly represented by the genera *Emarginula* and *Rimula*, while those of the palæozoic formations are very scarce and rather peculiar, so as to form probably a separate group.

The following will give a short review of the generic characters of the shells belonging to this family; a monograph of it has been published a few years back in Sowerby's Thesaurus Conchyliorum, but I am sorry that I cannot refer to the work just at present, it not having been yet received in Calcutta.

1. *Scutus*, Montf., 1810; shell rather thick, depressed, very oval; apex posteriorly pointed, slightly incurved; outer surface with concentric striæ of growth, and occasionally with some lateral, thin radiating ribs; aperture anteriorly truncate or emarginated, the emargination being externally on the shell traceable by the indentation of the striæ of growth.

There are a few tertiary species of *Scutus* known (*Sc. Bellardi*, Mich.), but I do not think that any of those described by Deshayes from the Paris basin under the generic name *Parmophorus* belong to this genus. Pictet and Hörnes have already remarked, that the shell of those species, noticed by Deshayes, is very thin, and is neither truncate nor emarginated in front. Comparing the last figures (in Deshayes' Anim. s. vert., 2nd edit., vol. II, pl. 8), it will be seen that the horse-shoe shaped, muscular impression of the Paris specimens does not agree with the impression of the shell of *Scutus*, in the living specimens of which such an impression does not at all exist, the adductor muscle being entirely attached to the top of the shell, from near the margin to the apex. I believe that all the species of Deshayes' *Parmophorus* belong to *Nacella* or *Patina*, a genus of the *Tecturidæ*.

1 a. *Tugalia*, Gray, 1853 (*Tugali* apud H. and A. Adams, Gen. I, p. 455) only differs from *Scutus* in having the upper surface cancellated, and the margin of the aperture crenulated and deeply insinuated in front.

2. *Emarginula*, Lamarck, 1801. Shell cup-shaped, with the apex incurved, spiral, posterior, aperture in front with a median slit.

2 a. *Sub-emarginula*, Blainville, 1825, has the shell usually somewhat irregularly oval, the surface covered with unequal, often tubercular ribs, and the anterior emargination very short. The latter is occasionally somewhat lateral, as in the cretaceous *Em. neocomiensis*, D'Orb., or in *Emarg. impressa* and *galericulus* of Ryckholt, though these fossil species have the slit much deeper than any recent *Subemarginulæ*, and will probably have to form a distinct subgenus. The devonian *Emarg. conoidea*, Goldf., belongs to the *Capulidæ*.

2 b. *Clypidina*, Gray, 1847, has the surface cancellated or spinose, aperture with a single groove in front on the right side, extending to the apex and resembling that of *Siphonaria*.

Gray also places *Deridobranchus*, Ehrb., in this family, stating that the animal is like that of *Emarginula*, without any shell; the front of the mantle being plaited and covering the pectinate gills. Upper tentacles are said to be none, lower "two" and the "eyes at the base of the lower tentacles." I cannot make out the meaning of *upper* and *lower tentacles*, but in the Op. Nudibranchiata there are occasionally somewhat similarly formed Molluscs to be met with, in which various appendices on and above the head can be mistaken for tentacles.

3. *Zeidora*, Adams, 1860 (Ann. mag. nat. hist., V, p. 301), has a shell like *Emarginula*, with the margin of the aperture crenulated and anteriorly deeply fissured, but there is posteriorly an internal, flat, semilunar septum present, which distinguishes this genus from any other *Fissurellidæ*.

4. *Rimula*, Defr., 1824. Shell cup-shaped, generally cancellated, apex incurved, subspiral, posterior, with an elongated, median perforation in front, situated about equally distant between the margin and the apex. Species of this genus are known from the Trias upwards, but they are always rare; from cretaceous deposits none have as yet been reported; of living species there are five or six known.

4 a. *Cranopsis*, Adams, 1860 (Ann. mag. nat. hist., V, p. 302), only differs from the former genus in having an "internal vaulted chamber over the foramen," resembling that of *Puncturella* (or *Cemoria*). *Cr. pelex*, Adams, from the China seas is the type, and the same author has since described one or two additional species, also from the eastern seas.

4 b. *Puncturella*, Lowe, 1827 (*Cemoria*, Leach, *teste* Gray and Swainson, 1840), in form and ornamentation resembles *Rimula* and *Cranopsis*, but has the foramen placed in front near the apex, "vaulted over internally with a shelly plate." At present only about eight or ten recent, and a few fossil, species from tertiary deposits have been reported.

5. *Fissurella*, Bruguiere, 1789; shell cup-shaped, with the apex truncate and a foramen in front of it, internally surrounded by a thickened margin. The young shells are said to have the apex entire and sub-spiral.

There have been several forms distinguished by separate names, as—

5 a. *Cremides*, H. and A. Adams, 1854, having a rough, cancellated and strongly ribbed upper surface.

5 b. *Fissuridea*, Swains., 1840, is distinguished by a depressed, narrow form and an apex close to the posterior margin.

5 c. *Lucapina*, Gray, 1840, includes the cancellated species with a crenulated margin of the aperture, and the perforation surrounded by a somewhat more thickened edge, than is usually the case in typical *Fissurellæ*. The animal of *Lucapina* has the mantle large, partially covering the shell. I do not think that the crenulation of the margins can be considered as having a generic value, for it is quite clear that the ribbed species *must* have crenulated margin, otherwise the ribs could not be formed, and it is only by the occasional development of an internal thickened layer that the crenulation of the extreme margin becomes obliterate.

5 d. *Glyphis*, Carp., 1856. (*Capiluna*, Gray, 1857, Guide, p. 166). This was proposed for *Fiss. Cuvieri*, the shell of which does not differ from the last, but the mantle of the animal is not so much expanded, covering only the outer edge of the shell.

5 e. *Clipidella*, Swains., 1840. Shell rather depressed, surface cancellated, anteriorly truncate or slightly emarginated, perforation usually somewhat anterior. The animal has a rather thick, tuberculated foot, provided on the sides of the front part with a few short filaments; the edge of mantle is double, crenated and partially covering the shell.

5 f. *Fissurellidæa*, d'Orb., 1840. Shell depressed, nearly smooth, foramen large, elongated, nearly central. The animal has the mantle largely developed,

almost coriaceous, thickened on the edge, and covering the greater portion of the shell; the foot is oblong, with a lateral, crenulated fringe.

5 g. A peculiar subgeneric type appears to be represented by the *Fissurella Nystiana*, Ryckholt, from the Turonien beds of Montignies-sur-Roc (Belgium). The shell is conically elevated, like a *Puncturella*, ornamented with radiating, rather thick ribs; the apex is subcentral, pointed and curved anteriorly, with a small, circular opening below it.

6. *Pupillia*, Gray, 1840. Shell depressed, thin, almost smooth, foramen oblong, very large, subcentral, margin of the aperture with a sharp edge. The mantle of *Pupillia* covers the shell entirely. The only species known is *P. apertura*, Born.

7. *Macrochisma*, Swains., 1840. Shell oblong, depressed, rather thick, surface usually radiated with lines, subtruncate in front, foramen very elongated and anterior. There are about 12 recent and a few tertiary species known.

Comparing the fossil species of the *Fissurellidæ* with the recent ones, it is very remarkable to notice that, while the *Emarginula*-forms appear to be decreasing, the *Fissurella*-forms are increasing in number, the former being comparatively much less rare in fossil state than the latter. The contrary appears to be the case with the recent *Fissurella*, of which (including the subgeneric forms which we have quoted) about 180 species are known, while those of *Emarginula* and allied genera are not more than 70 or 80.

Pictet and Campiche (Pal. Suisse, 3me. ser., pp. 708-712) catalogue 47 species of *Emarginula* and 9 species of *Fissurella* from cretaceous deposits.

To the number of *Emarginula*, quoted in Pictet and Campiche's list, the following have to be added: *Emarg. conica*, *Dewalcquii*, *radiata*, *Hoeveni*, *depressa*, *clypeata*, *Kapfi* of Binkhorst (Gast. et Ceph. craie de Limbourg, 1861, pp. 55-58 and p. 82), and *Em. radiata*, Gabb (Pal. Calif. I, 1864, p. 140, etc., non *idem*, Binkhorst). Guéranger (Album paléont. de la Sarthe, 1867, pl. XIV,) gives figures of the following species, previously named in his Repertoire of 1853, *Em. nodosa Cenomanensis*, *striata*,* *compressa* and *granulosa*. The previously named *Em. pseudoreticulata* is here omitted, but *Em. conica* (an *idem*, Binkhorst? !) is newly added. A single species of *Emarginula* occurs in our South Indian cretaceous deposits, but strangely enough not a single species of any of the other genera belonging to this family has as yet been found.

I may mention that Pictet and some other palæontologists also refer *Bellerophon* and *Bellerophina* to the *Fissurellidæ*, though I rather think that these genera belong more probably to the Heteropoda,† or to the Opisthobranchia. From cretaceous rocks the only known species is *Bellerophina minuta*, Sow., sp. (= *B. Vibrayei*, d'Orb.). A. Adams described some time ago a recent species of *Bellerophina* from the Japan seas.

* Probably identical with *Em. pelagica*, Passy.

† It is remarkable to notice how very much some of the species of *Bellerophon* resemble those of *Argonauta*, and it is after all not improbable that the animals of *Bellerophon* were true Cephalopoda.

XCVII. EMARGINULA, *Lamarck*, 1801.

1. EMARGINULA *sp.* (*conf.* E. GUERANGERI, *d'Orb.*), Pl. XXVIII, Fig. 8.

We only possess a fragmentary specimen, and even this devoid of the shell surface; there are, however, radiating, stronger and thinner ribs distinctly traceable, the former numbering about 24 on the periphery. The concentric striæ are rather thin, the slit is anterior and mesial, not extending more than one-third of the distance from the edge to the apex, bounded by a raised rib on either side; apex excentric, posterior and apparently somewhat incurved. The height and the oval shape of the whorl agrees, as likewise do all the remaining characters, with d'Orbigny's *Em. Guerangeri*, of which two good figures have lately been supplied by Guéranger in his "Album paléontologique de la Sarthe," 1867, pl. 14, figs. 24 and 25. It is probable that our Indian fossil is identical with the French species occurring in the upper beds of the Gault.

Locality.—North of Odium, in calcareous, conglomeratic sandstone; apparently very rare.

Formation.—Ootatoor group.

Order. OPISTHOBRANCHIA.

Char. *Gastropoda with gills situated behind the heart, covered by the mantle or exposed; hermaphrodites; larvæ shell-bearing, with two deciduous cephalic fins.*

The OPISTHOBRANCHIA are almost without exception inhabitants of the sea; the general form of their body is elongated and nonsymmetrical, in so far as the genital organs are almost invariably placed on the right side. The head is distinct, provided with two, often thickened, tentacles, and sometimes also with labial lappets. The mantle is usually only partially developed on the back, sometimes secreting a more or less spiral shell, but not uncommonly the body is quite naked.

The radula is usually composed of a large number of uniform teeth, of which the central ones are occasionally wanting; the stomach is sometimes provided with horny plates for the purpose of maceration of the food, the liver generally highly developed and sometimes extending into the lateral branches of the body. The circulation of the blood is not complete, the auricle of the heart being situated behind the ventricle, which receives the blood from behind and sends it to front, but the arterian vessels terminate by imperfect canals at the gills. The nervous system consists of three well developed pairs of ganglia, being the centres of the cerebral system, one providing the mantle and the gills, and the third pair providing the foot. The gills are represented by a single or double plume, or by numerous plumes; they form in a great measure the basis for farther sub-divisions in this order.

The sexes are always united in the OPISTHOBRANCHIA. The hermaphrodite organ is composed, according to the latest researches of Pagenstecher, of a distinct *penis*, being near its tip connected with an inflated *vesicula seminalis* and a very long *vas deferens;* there is also a distinct *vagina* and a large pyriform *receptaculum seminis*

present. The penis and the vagina are placed together in a cavity on the right side of the neck. The ova and the spermatozoa are, however, formed in the same follicles, the former peripherically, the latter more centrally and basal. The connection of the follicles with the sexual organs has not yet been distinctly traced out. A reciprocal impregnation seems to be the general rule among OPISTHOBRANCHIA, but Nordman states that he obtained ripe ova from *Tergipes*, which had been kept solitary, so it is probable that under certain circumstances they are also self-impregnating.

According to observations made on the animal of *Tergipes*, the embryo after leaving the egg is provided with a ciliated fringe and two cephalic fins, secreting very early a transparent homogeneous shell, composed of one whorl; in place of the foot there is a kind of veil or rudder; and a very minute operculum is also present. The larva thus furnished swims with great activity, but after a short time it drops the shell and the operculum, absorbs the fins, the body becomes somewhat elongated, and the young animal then resembles in every way the old one. This kind of development appears to apply specially to the naked families, but in those provided with a shell, like the *ACTÆONIDÆ*, the smooth embryonal whorls remain preserved and grow by distinguishable striæ of growth into a more or less large and spiral shell.

Gray calls this order HETEROBRANCHIATA on account of the various forms of the gills, but he excludes the *ACTÆONIDÆ* from it, placing them in the PROSOBRANCHIA.

As to the sub-division of the OPISTHOBRANCHIA most conchologists agree in distinguishing two groups, the so called TECTI- and the NUDI-BRANCHIATA. Bronn (Klassen und Ordnungen des Thierreiches, vol. III, p. 794) says that this order offers a beautiful example of the development of separate organs designed for special kinds of work, their relative concentration progressing in the same degree as does the whole organism. This progressive development is especially apparent in the gills, which, therefore, are very useful in distinguishing sub-divisions. Lowest in the series of organisation stands *Rhodope*, the body having a discoidal shape, without special gills, heart, or any vascular system. The gradual development of the gills may shortly be expressed thus; at first the entire surface of the body acts as a respiratory organ, especially at the back, then different appendages are formed for the purpose of increasing the space to come in contact with the oxygen; these appendages are afterwards differently ramified and form themselves into regular gills, being connected with various internal canals and blood-vessels; these gills which are at first spread over the whole body arrange themselves afterwards round the anal opening, then again they seek protection under a lappet of the mantle, which at last secretes a more or less thickened, flat or spirally coiled shell, the gills being then lodged in a sort of an open cavity. The shell gradually grows spirally to a size, sufficient to give full protection to the retracted animal and is closed by an operculum; in this state it can hardly be distinguished from the shells of the PROSOBRANCHIA, except by its usually punctated surface.

In the following pages I shall accept the sub-division of the OPISTHOBRANCHIA, according to Bronn,* into PLEUROBRANCHIATA and NOTOBRANCHIATA, the former including the species in which the gills are more or less covered by the mantle, and the latter those in which they are uncovered, being exposed freely or represented by a simple ciliated surface of the back. These two divisions are equivalent to those of Philippi's† TECTI- and NUDI-BRANCHIA, or to H. and A. Adams' TECTI- and NUDI-BRANCHIATA,‡ but the names introduced by Bronn appear more correctly applicable.

The NOTOBRANCHIATA are all naked Mollusca, and, therefore, very unfavorable for preservation in a hard rock. There have not yet been any fossil species reported, but the possibility of such being found in the fossil state is sufficiently exemplified by the discovery of larvæ of insects and even medusæ in the lithographic slates of Solenhofen, animals which often have a much softer body than many of the NOTOBRANCHIATA. Bronn divides this sub-order into five tribes, DERMATO-, PLACO-, CERA-, CLADO-, and PYGO-BRANCHIATA, and these again into a number of families. Not having any fossils from the cretaceous rocks of South India to report as belonging to any of the divisions of the NOTOBRANCHIATA we shall not enter farther into any discussion on their organisation.

Sub-order, Pleurobranchiata.

Char. *Opisthobranchia with gills consisting of a tuft, a uni- or bi- serial plume, or of numerous lamellæ, generally unsymmetrical, but always more or less covered by the mantle, the latter usually secreting a lamella-like, cup-shaped, or spiral shell.*

There are two divisions made in this sub-order, called DIPLEURO- and MONOPLEURO-BRANCHIATA. The former have the gills consisting of numerous lamellæ, placed almost symmetrically on either side under the edge of the mantle, somewhat similar to some of the POLYPLACOPHORA; they are separated only into two families, *PHYLLIDIDÆ* and *PLEUROPHYLLIDIDÆ*, the animal of both having a somewhat leathery skin, but none or a very rudimentary shell. We shall, therefore, only notice the second division.

Tribe, Monopleurobranchiata.

The species included in this tribe have the branchial plume,—with the exception of *Posterobranchæa*, D'Orb.,—placed on the right side; there are all gradations in the development of the shell to be met with, it is rarely wanting, sometimes imbedded in the mantle, but more usually external, symmetrical in the *UMBRELLIDÆ*, flat and small in the *APLYSIIDÆ*, spiral in many other families, in the *ACTÆONIDÆ* so large as to cover perfectly the animal when retracted.

* Klassen und Ordnungen, III, p. 795.

† Handbuch der Conch., 1853, pp. 222 and 265.

‡ Troschel generally accepts a three-fold division in the order of the OPISTHOBRANCHIA, namely, NOTO-, MONOPLEURO-, and HYPO-BRANCHIATA.

H. and A. Adams state that, observed under favorable circumstances, the MONOPLEUROBRANCHIATA are by no means sluggish and unattractive, but that they contribute, by their changing form and lively colours, to lend animation to the weedy shores and the coral reefs among which they take up their abode.

The following families have been distinguished in this tribe:—

LVIII.—*ACTÆONIDÆ.*
LIX.—*BULLIDÆ.*
LX.—*OXYNOEIDÆ.*
LXI.—*PHILINEIDÆ.*
LXII.—*APLYSIIDÆ.*
LXIII.—*PLEUROBRANCHIDÆ.*
LXIV.—*RUNCINIDÆ.*

H. and A. Adams, Gray and other conchologists distinguish a somewhat larger or smaller number of families, though these do not as yet appear to be well founded. It is well known that the animals of the PLEUROBRANCHIATA are very variable in form, though they generally agree in the great development of the frontal disk. The teeth show slight differences in almost every few species that have been examined, and it seems consequently very hazardous to separate closely allied shells, because one species happens to have no central teeth, or one or two laterals more, or again because the frontal veil is a little more produced, or a little less rounded. There is no reason why these characters ought not to be used quite as well as many others, but a far more detailed examination of the various living forms is required before we are able to come to a definite conclusion as to the arrangements which ought to be adopted. I would only remark that in this particular case the characters of distinctions are mostly those which exhibit the greatest variations in this group. The shells, so far as known, give little support to many sub-divisions.

The fossil forms belonging to this tribe are rather numerous; the cup-shaped forms begin already in the lower palæozoic epoch, while the spiral forms are not with sufficient accuracy known below the carboniferous strata.* They become, however, pretty numerous already in the Trias. I shall give brief notes on some of the fossil forms when speaking of the separate families; but I may already here remark that since several of the fossil genera (as, for instance, *Actæonina* and others, being certainly closely allied to *Actæon*), do not always agree with the characteristics of the families, as deduced from the recent species alone, some changes in the limits of these families must be made.

It appears hardly necessary to enter into any detailed discussion on the three last mentioned families, namely, the *APLYSIIDÆ*, *PLEUROBRANCHIDÆ*, and *RUNCINIDÆ*, as there are scarcely any cretaceous shells known which can be referred to them. The different genera belonging to these families will be found treated in H. and A. Adams' Genera, II, pp. 32-43, and in Gray's Guide of 1857, p. 198, etc. Of the *APLYSIIDÆ* and the *RUNCINIDÆ* in particular there are scarcely any fossil species known, but of the *PLEUROBRANCHIDÆ*, especially of the sub-family

* *Actæonina* (*Chemnitzia*) *carbonaria*, Kon., Anim. foss. terr. carb. de Belgique, pl. 41, fig. 15.

OPERCULATINÆ (= *UMBRELLIDÆ, auctorum*), including *Operculatum* and *Tylodina*, there are many species known from the Silurian deposits upwards. Of cretaceous shells I may draw attention to the genus *Anisomyon* of Meek and Hayden, which I have mentioned, p. 325, in the family *LEPETIDÆ*. The shells are very closely allied to *Tylodina*, being thin, patelliform, with a pointed, recurved apex, supposed to be perforated. Gray (Guide, 1857, p. 203), however, says that the shell of *Tylodina* has a globular, spiral and sinistral nucleus and the muscular impression with a sinus on the right side, while in *Anisomyon* the muscular impression is said to be interrupted in front above the head, as in *Lepeta*.

LVIII. *Family,—ACTÆONIDÆ.*

The animals of the *ACTÆONIDÆ* have been observed only in very few instances. Though generally perfectly retractile, they are mostly of large size when expanded, having a large thick foot, reflexed on the sides; head broad, very often forming a flat disk, with or without other appendages; the tentacles are broad, thick, united at the base, but generally separated at their tips, the eyes being sessile above near their base. The teeth are numerous, uniform, arranged in diverging cross series, the central ones are wanting.

Operculum, when present, horny, ovate, narrow, composed of few whorls.

The shell is spiral, ovate, convolute or involute, with more or less elevated spire, mostly spirally punctuated, the aperture is usually high and narrow, truncate or roundish in front, the columella usually solid.

Important characters of the shell of the *ACTÆONIDÆ* are the large size of the last volution and its usual spiral punctuation, which appears to be only very rarely wanting. Meek's last monographic exposition* of the family is in many respects very imperfect, and, notwithstanding the great desire of introducing new genera, the author has omitted many which were already known; he could scarcely have examined any of the fossil forms, otherwise I think that he could not have regarded some of the most unimportant and accidental† distinctions as of generic value.

a. *Sub-family,—ACTÆONINÆ.*

Shell ovate, aperture anteriorly rounded, sometimes broadly effuse, outer lip sharpened at the margin, columellar lip twisted and often plicated in front; the recent species have an operculum.

This is the largest and oldest group of *ACTÆONIDÆ*, the first forms not possessing a columellar fold, probably beginning already in the Silurian; at least some of the species described by Eichwald very much resemble *Actæonina*. From the carboniferous beds the *Chemnitzia carbonaria*, Koninck, and others are known to belong to *Actæonina*. In the Trias the species become more numerous, and some of them already very closely resemble recent forms of *Actæon*. Other species are found

* American Journal of Sc. and Arts, XXXV, 1863, p. 89, etc.

† Being sometimes only dependent upon the state of preservation of the shell.

through all the successive formations, but they never are very common or very numerous, with the exception of a few from brackish water deposits. With regard to the classification of the cretaceous species I shall defer my remarks to the end, after having given previously a review of the genera. Seeing the great confusion, already existing, introduced by some recent comments on evidently imperfect figures, it will be advisable not to make any essential changes in the generic determination, unless specimens of the same species or the originals have been examined. The following are the principal generic forms constituting this subfamily.

1. *Actæonina*, d'Orbigny, 1850. Shell turreted or ovate, moderately thick, with more or less elevated spire, inner lip flatly thickened at the edge, not plicated or twisted, aperture evenly rounded in front; the last whorl being always anteriorly somewhat suddenly contracted. The surface of many *Actæoninæ* appears to be perfectly smooth, but it is more likely this is only in consequence of the uppermost punctated layer of the shell having been removed; transverse ribbings are comparatively rare, and if present they generally become obsolete on the last whorl.

Meek (l. cit., p. 91) proposed for species, like *Act. ventricosa*, d'Orb., and others, being merely distinguished by a shorter spire and a more inflated last volution, the sub-generic name *Trochactæonina*. When, however, we examine a large number of specimens of any of the species of *Actæonina* (or *Trochactæon*, *Actæonella* olim), we may be certain to find among them some which are more cylindrical, others which are more inflated at the last volution, and the last form is almost invariably connected with a shorter spire. Thus we observe variations which hardly can be considered as being constant in a species, and it seems to me, therefore, that they ought not to be used in distinguishing genera, though they may under circumstances have a specific value and sometimes be of great importance for local faunas. There is a continued series to be traced from such forms, which have the spire plane, or even a little immersed (*Orthostoma conulus*, Buv., Stat. de la Meuse, etc., pl. 24, figs. 16-17; or *Act. brevis*, Lyc. foss. Great Ool. Suppl., pl. 41, fig. 6), to those which have the same slightly (*Actæon. ventricosa*, d'Orb., or *Act. Luidii*, Morris), or more strongly elevated (*Act. sparsisulcata*, d'Orb.), and from these again to forms in which it almost exceeds the last whorl in height.

The species of *Actæonina* begin in the carboniferous formation, being most numerous in the jurassic period, but they decrease very considerably in the cretaceous, continuing, however, up into the eocene formation, for the *Ampullaria problematica*, Desh. (Paris fossils, II edit., pl. 36, figs. 1-2) must be considered as an *Actæonina*, and Deshayes besides describes an *Orthostoma conoviliformis* (Par. foss., I ed., pl. 6, figs. 9-11).

Deshayes claims (Paris fossils, II ed., II vol., p. 613) the priority of his name *Orthostoma* against that of *Actæonina*, the former having been published first in 1842; but long prior to this in 1831, and afterwards in 1834, the same name was applied to totally different animals by Ehrenberg and by Audouin; consequently d'Orbigny's name for these shells must be retained.

2. *(Auriculina)*, Gray, 1847, non *idem*, Grateloup, 1838 (H. and A. Adams, Gen., I, p. 233). "Shell ovate, thin, ventricose, whorls simple or concentrically striated, columella edentulate, without a plait." H. and A. Adams considered *Auriculina* as a sub-genus of *Odostomia*, but A. Adams (Ann. mag. nat. hist., 1860, V, p. 407), when describing *Auriculina Grayi* (dredged in 63 fathoms of water), says that it may more probably belong to the *Actæonidæ*, and it seems to me that it is the representative of the fossil genus *Actæonina*. I have no recent shells belonging to *Auriculina* to compare, but I strongly suspect that they will be found generically identical with *Actæonina*, in which case it will be unnecessary to propose for the recent shells a new name.

3. *Euconactæon*, Meek, 1863 (Americ. Jour. Sc. and Arts, XXXV, p. 91) is distinguished by its *thin, obconic shell, gradually tapering anteriorly, the spire is either immersed or elevated, the aperture very long, equally narrow all through, anteriorly rounded, columella slightly thickened, smooth.* The typical forms *Euc. Caumontii* and *concavus* of Deslongchamps and others very much resemble in form a *Conus*, from which they differ by their very thin shell and the anterior roundness of the aperture. The surface is usually smooth or spirally striated, and the spire is plane or somewhat immersed. The thinness of the shell and its regular obconic form, inasmuch as the last whorl is not suddenly contracted towards the anterior termination and the aperture not sensibly widened in front, must be considered the principal generic distinctions from *Actæonina*. Meek (loc. cit., p. 92) suggests for the *Conus Cadomensis* of Deslongchamps the sub-generic name *Conactæon*, but I do not think that the distinction, referring to the elevation of the spire, can be considered sufficient, for the same reasons which I have stated when speaking of *Actæonina*.

The species of *Euconactæon*, so far as known at present, are all jurassic.

4. *Cylindrites*, Morr. and Lyc., 1854 (Moll. Great Ool., p. 97). *Shell sub-cylindrical or ovate, smooth, spire sunken or moderately elevated, aperture narrow, very high, anteriorly rounded, sub-effuse, columella twisted anteriorly into a distinctly conspicuous fold.*

The *Cylindrites* differ from *Actæoninæ* by the twisted columella; they are like these generally smooth. Meek (loc. cit., p. 91), again proposes for a few species, like *Cyl. brevis*, M. and L., and others which have a very short or immersed spire, a sub-genus, *Goniocylindrites*, but the distinction of a separate name cannot be accepted.

I only know as yet triassic and jurassic species belonging to this genus. Meek refers to it *Conus cylindraceus*, Geinitz, which is probably a *Cylichna*. Gabb described a *Cylindrites brevis* (non *idem*. M. and L.) which is either an imperfect shell belonging to some genus of the *ringiculinæ*, or has to be considered as the type of a new genus. I shall subsequently mention a somewhat similar form from our cretaceous rocks.

Some of the species of *Cylindrites* very closely approach in form to *Ceritella* (or *Tubifer*, see antea p. 189), which is, however, stated not only to possess a twisted

columella, but a short anterior canal. It would be very interesting to compare perfect specimens of both these genera together. Meek's (loc. cit., p. 88), proposition of *Costellifer* for the buccinoid and transversally ribbed species of *Ceritella* appears to me to have no foundation.

5. *Bullina*, Férussac, 1821 (*Tornatina*, Adams, 1850; H. and A. Adams, Gen., II, p. 12), has the general form of *Cylindrites*, being involute with a distinct, more or less elevated, spire; the suture is canaliculated, the inner lip has a columellar plait, but it appears to be placed somewhat higher than in the previous genus.

There are few mesozoic species known which can be correctly referred to *Bullina*, but the tertiary ones are tolerably numerous. The recent species are not only deep-water shells, but several of them are also found in brackish water. I believe that *Bullina* stands in precisely the same point of relation to *Cylindrites* as (*Auriculina*) of Gray does to *Actæonina*. It is indeed very difficult to make strict distinctions between any of these genera.

Gray in his Guide of 1857 unites H. and A. Adams' two genera, *Bullina* and *Cylichna*, into one under the former name. Deshayes in his last edition of the Paris fossils, p. 619, etc., keeps them distinct, but he correctly replaces the name *Tornatina* by that of *Bullina*, admitting at the same time the existing great confusion as regards the names of several allied forms. Considering the strict rule of priority the retaining of the name *Bullina* appears correct. Férussac first proposed this name for some species of the old genus *Bulla*, which have a distinct spire, like *Bulla aplustrum*, *undata*, *truncata*, and allied forms. The first species had already, in 1817, been called *Aplustrum* by Schumacher; for the *Bulla undata*, Brug. (which is the same as *B. lineata*, Sow.), Beck proposed, according to Swainson, in 1840, the name *Bullinula* (Treat. of shells, p. 360), and consequently the name *Bullina* of Férussac remains for the species like *B. truncata*, for which *A. Adams* suggested the name *Tornatina*.

6. ? *Actæonema*, Conrad, 1865. Amer. Journ. Conch. I, p. 147; Check List Eocene foss. of N. America, 1866, p. 9; shell conical, aperture suboval, reflected at the base. Conrad refers to this genus among others the two species, *Pasithea striata* and *sulcata*, described in Lea's 'Contributions to Geology,' these shells being apparently generically not distinct from *Aclis* (*Eulimidæ*). In neither of the descriptions of those two species does Lea mention the existence of a columellar fold, though he says that the lip is anteriorly somewhat flattened. In his previous catalogue of the Eocene and Pliocene fossils (Am. Journ. Conch. I, 1865, p. 35) Conrad proposes for *Pasithea striata*, Lea, the name *Cœlatura*, which he subsequently (*ibid.*, p. 147) replaces by that of *Actæonema*.

7. *Myonia*, Adams, 1860 (Ann. mag. nat. hist., V, p. 406). Shell ovately turreted, thin, generally spirally sulcated; aperture oblong, anteriorly a little produced, inner lip somewhat posteriorly with an oblique fold. The species belonging to this genus were at first (Sowerby's Thesaurus) described by A. Adams as *Monoptygma*, which genus represents a perfectly different type of shell, belonging

to the *Pyramidellidæ*. This last specific name has as yet to be reserved for species, like *M. Alabamiensis* (Contrib. p. 186, pl. 6, fig. 201), which is a shell in form resembling an *Ancilla*, being anteriorly truncated and possessing on the posterior portion of the inner lip an oblique fold, *M. curta* and *Leai*, Con. (Am. Journ. Conch. I, pp. 143 and 261) being very similar forms. Lea (loc. cit., p. 185), says that he obtained by a vessel coming from Calcutta a small recent shell which, he thinks, belongs to the same genus, distinctly pointing to a sinus at the base and a simple columellar fold, but in form resembling a *Melania*, for which reason he calls it *Monopt. melanoides.*

7 a. *Leucotina*, Adams, 1860 (Ann. mag. nat. hist. V, p. 406), with the recent type species *L. Niphonensis*, only differs from *Myonia* by a somewhat more ventricose form of the last whorl. A. Adams calls the shell intermediate between *Myonia* and *Actæon*. I do not know any cretaceous species which distinctly resemble the typical one of *Myonia*, but D'Orbigny figures an *Actæon marginata* (Pal. franç. cret. II, pl. 167, fig. 8) which could be referred to *Leucotina*, having the fold rather posterior and the aperture anteriorly produced.

8. *Actæon*, Montfort, 1810 (*Tornatella*, Lamarck, 1812). There is only a slight gradual distinction between the genera *Actæon* and *Myonia*; in the former the spire being always shorter than the last whorl, while in the latter the spire is of greater height, and in *Leucotina* of about the same as the last volution.

8 a. *Solidula*, Fischer, 1807 (*Buccinulus*, Plancus, apud H. and A. Adams, Gen., II, p. 5) is distinguished by two (and occasionally more) folds on the columella and by a somewhat thicker shell. In comparing the recent species of *Actæon*, as lately monographed in Reeve's Conch. Icon., Vol. XV, it must be agreed that no strict generic distinction between *Actæon* and *Solidula* can be given. It is true, and can often be observed in the fossil forms also, that those species which have a double columellar fold generally are stout and strongly built shells, but at the same time there are among those with one fold, some which have an equally strong shell, though, as a rule, they are thinner. The distinction is therefore only an optional one, and in determining fossil species it is not easy to keep it up even within approximate limits. In fact *Myonia* and *Leucotina* also could be considered as sub-generic divisions of *Actæon*.

Species of *Actæon* are known from the Trias upwards.

8 b. *Tornatellæa*, Conrad (Am. Journ. Conch. I, 1863, p. 145; Check list eocene fossils, 1866). The author quotes three species, of which *T. impressa* (*Actæon id.*, Gabb, Pal. California, I, p. 142) either belongs to the sub-generic group *Solidula* of *Actæon*, or more probably is an imperfect *Ringicula*.

9. ? *Triptycha*, Müller, 1859 (Suppl. to 1st and 2nd part of Monograph, Petræf. Aach. Kreidef., Aachen, p. 21) with the type species *T. limnæiformis*, from the Senonien beds near Aachen. *This is an ovate, almost perfectly smooth shell, with an aperture anteriorly rounded, possessing a sharp outer margin and an inner lip with three folds, of which the middle one is the strongest.* There was only one specimen found of this remarkable shell, associated with marine species, still I very much

doubt that it belongs to this family. It is much more probable that the shell is a *Marinula (Auriculidæ)*, which only differs by usually having the posterior fold the strongest. That the shell occurs in marine beds in itself proves nothing, for most of the present *Auriculidæ* live on the sea-shore, often between tide marks, and the dead shells are found everywhere with truly marine species. I have myself dredged a dead shell of *Pedipes* in about six fathoms of water in the Aden harbour with living *Ringiculæ*, *Ancillæ*, *Turritellæ* and others.

10. *Trochactæon*, Meek, 1863 (*Actæonella*, d'Orbigny and auctorum *ex parte*, Am. Journ. sc. and arts, XXXV, p. 89). Shell turbinate, more or less involute, last whorl usually higher than the spire, with a narrow flattened and solid edge along the suture; aperture semi-effuse, anteriorly rounded, inner lip thickened, especially in front, and provided with three oblique folds.

It would no doubt have been preferable to retain the name *Actæonella* for those involute forms, the first of which, *Act. Renauxiana*, was figured and described by d'Orbigny under that genus, as stated in my revision of the Gosau-Gastropoda, published in 1865 (Sitz. Akad., Wien, LII, p. 515). When writing those notes in 1864 I was not in possession of the January 1863 number of the American Journal, and proposed consequently for the convolute forms, like *Act. lævis*, for which Meek has retained d'Orbigny's name *Actæonella*, that of *Volvulina* (vide *ibidem*, p. 519); as, however, Meek's proposition has priority before my own I have here accepted it. The sub-generic name *Spiractæon*, which Meek proposes for certain species with a more conical spire, has, however, no foundation whatever. It will be seen from my notes on the Gosau-Gastropoda (loc. cit., p. 517) that the *Act. obtusa*, Zek., which Meek quotes as one of the species of *Spiractæon*, is in reality only a variety of *Act. gigantea*, which he places in *Trochactæon*.

b. *Sub-family,—APLUSTRINÆ.*

The animals of this sub-family agree in general form and dentition with the former, but the frontal disk usually has large appendages, folded over the back of the shell; the mantle margin is also somewhat more developed, than in the *ACTÆONINÆ;* an operculum is not known.

The shells in general form, texture and ornamentation resemble those of the former sub-family; *the spire is usually short, the last whorl inflated, the aperture anteriorly distinctly effuse, the columella somewhat thickened, rarely twisted, but always anteriorly truncated.*

The species are first known from the jurassic deposits, and continue in small number to be noticed through all the successive formations; they appear to have been in former times rather rare shells, and the recent species are only found very locally distributed.

11. *Etalonia*, Deshayes, 1864 (Paris foss., 2me. ed., p. 605). Shell ovate, attenuated on both ends, spire elevated; aperture narrow and high, anteriorly truncated, columella thick, twisted in the middle with an obscure fold. The two

species, *E. cytharella* and *prisca*, which Deshayes describes from the Paris basin, are both transversally ribbed and have an elevated pointed spire, but otherwise they much resemble the next genus. I am not acquainted with any other species belonging to this genus, and as its form is so extremely like many others belonging to the *Pleurotomidæ*, to the *fusinæ* of the *Muricidæ*, and also to the *mitrinæ*, it is not advisable to form opinions from mere drawings, especially when the shells are not perfectly preserved for generic determination.

12. *Bullinula*, Beck, 1840 (*Bullina*, Fér. apud H. and A. Adams, Gen. II, p. 8). Shell ovate, with a short spire, last whorl ventricose, embryonal whorls smooth and mammillated, rest of the surface spirally striated, outer lip thin, inner sometimes partially covering the shell, columella thickened, often slightly hollowed out, occasionally somewhat twisted, anteriorly obliquely truncated, the outer lip being somewhat produced and effuse.

The two oldest species apparently belonging to this genus are the jurassic *Actæonina pulchella*, d'Orb., and *Act. striato-sulcata*, Zittel and Goubert; they both differ from the recent *Bullinula* by having the columella more thickened and solid. Strictly speaking, the difference is very slight, for in the recent species the columella is not distinctly hollowed out, but in consequence of the inner lip being so loosely attached to the previous whorl as not to cover every furrow on the shell a slight fissure is produced; it is, however, by no means distinctly traceable in all cases. There is no very distinct columellar fold as usually in *Actæon*, but some species like *Bullinula scabra* have the columella distinctly twisted anteriorly at the termination and also in the middle; thus they very closely approach *Etalonia*.

I shall note a third fossil species from our cretaceous rocks, *Bull. obtusiuscula*, n. sp. I could also refer to the jurassic *Actæon Sedgwicki*, Phil., and *Act. pullus*, M. and Lycett, or to the cretaceous *Actæonina Icaunensis*, Pictet and Camp., and a few tertiary species described in Deshayes' last work, and others, but none of the existing figures are taken from such thoroughly perfect specimens as to make their generic determination sufficiently reliable.

13. ? *Kleinella*, Adams, 1860 (Ann. mag. nat. hist., V, p. 302) has an ovate, thin, umbilicated shell, with the surface cancellated, aperture anteriorly produced, inner lip not plicated. The shell is said to resemble *Actæon*, but is without a fold; from the reference to the form of the aperture and the thin outer lip and the hollow columella, I should think that the genus is closely allied to the previous one, if at all distinct from it.

14. *Aplustrum*, Schumacher, 1817 (H. and A. Adams, Gen. II, p. 6), differs from *Bullinula* by its smooth, somewhat thinner shell, more depressed spire, the columella being very thick, slightly twisted and truncated in front. The only species as yet known is *A. aplustre*, Linn., which, as Mr. G. Nevill tells me, is often found living on coral reefs at the South Coast of Ceylon, Mauritius, Bourbon, etc. No fossil species has as yet been noticed.

15. *Hydatina*, Schumacher, 1817. Shell partially or wholly convolute, thin, ventricose, smooth or spirally sulcated, generally marked with broad coloured

bands; columella rather thin, twisted, hollowed out. The recent species are also peculiar to the eastern seas, they live on coral reefs or sea-weeds. Of fossil species the jurassic *Bulla undulata*, Bean, *B. Loliolum*, Morr. et Lycett (Moll. Great Ool., p. 96, pl. 8, figs. 8 and 16), or the *Bulla pulchella*, Desh. (Paris foss., 2me. ed., pl. 40, figs. 19-21) and others may belong to this genus. Perhaps some of the species of *Globiconcha*, which are only known from casts, may also be referrible to *Hydatina*.

15 a. *Bullopsis*, Con., 1858 (Jour. Acad. Philad., 2 ser., III, p. 334, and IV, pl. 46, fig. 27), has the general form of *Hydatina* with a depressed spire and inflated last volution, but the inner lip has two close folds. The genus has been proposed for a cretaceous species from Mississippi, *Bull. cretacea*.

c. *Sub-family,—RINGICULINÆ.*

This sub-family was first proposed by Meek in the American Journal, vol. XXXV, p. 87. The shells in general resemble *Actæon*, except that they have the margins of the aperture strongly thickened and externally varicose, the columella is twisted or plaited, and always terminates anteriorly with a distinct fold, in front of which there is a groove or a kind of canal in the thickened margin, not, however, extending to the structure of the shell itself so as to be traceable by the striæ of growth.

The animal of *Ringicula*, the only recent genus belonging to this sub-family, resembles, according to Woodward, that of *Actæon*, but the teeth are like those of *Philine*, being only two in each series, large, converging, and curved almost in a semicircle; there are often one or two smaller outer laterals, the central ones are wanting; an operculum is not known.

Meek (Check list cret. foss. N. America, 1864, p. 34) says that from the examination of a drawing of a recent *Ringicula*, it appears that the animal has "a large well developed siphon, which lies (perhaps when the creature moves) folded back upon the body-whorl between two short unequal tentacular lobes." Meek concludes from this the priority of constituting a distinct family *Ringiculidæ* for these shells, a selection which, if the observation of the animal proves to be a correct one, as seems very probable, would appear quite appropriate. We retain here provisionally the group as a sub-family simply to be able to classify the fossil shells easier, than could be done otherwise.

The species belonging to the *ringiculinæ* first appear, so far as known, in the cretaceous period, being, however, here more numerous than at any subsequent time. The recent representative is *Ringicula*, with which I have compared well preserved specimens of all the other known generic types, and I must say that as far as structure and form of the shell, especially that of the margins of the aperture, are concerned, there is great difficulty in considering these shells as more than sub-generic forms of *Ringicula*. Their principal characteristics are the thickened margins and the anterior termination of the columella with a fold, in front of which there

is a groove. When the specimens are, however, not fully grown or imperfectly preserved on the lip, their distinction from species of *Actæon* or *Bullinula* occasionally becomes extremely doubtful.

16. *Cinulia*, Gray, 1840. Shell globose, spire short, surface spirally sulcated, aperture anteriorly produced, effuse, columella terminating with a single oblique and twisted fold. Meek (loc. cit., p. 92) properly, I think, suggests to retain this name for the type species, *C. globulosa* of Deshayes. The genus only differs from *Actæon* by the thickened outer lip. We have no Indian species of this type.

17. *Avellana*, D'Orbigny, 1842.* Shell globose, inner lip with two or three folds, one being anterior, often bipartite, placed at the termination of the columella, the other sub-anterior separated from the former by a deep insinuation of the lip; there is generally a third one placed about the middle of the inner lip, and one or two posterior, much shorter ones, but these are not constant.

Avellana incrassata, d'Orb., may be considered as the type of this genus. We shall note four species from our cretaceous deposits. The *Avellanæ* are shells of moderate size and always have a more or less globular form.

18. *Ringinella*, D'Orbigny, 1842. Shell ovate, with turreted spire, inner lip anteriorly with two or three oblique folds, of which the most anterior one is often bifid; anterior canal usually indistinct. There is no posterior fold present, but the lip sometimes forms in the middle a strong projecting angle.

Ringinella Clementina, D'Orb., or *Avell. Valdensis*, Pictet, may be considered as the types of this genus. One new species occurs in our Sth. Indian cretaceous deposits.

19. *Ringicula*, Deshayes, 1838. Shell ovate with pointed spire, inner lip anteriorly deeply indented, with two oblique folds only, in the middle often angular, anterior canal very distinct and deep. The species begin in the cretaceous period and continue up to the present time. We shall note two species from the cretaceous rocks of South India.

20. *Euptycha*, Meek, 1863 (Americ. Journ., XXXV, p. 93). Shell globose, aperture very narrow, one strong, often bifid, anterior fold on the inner lip, which is in the middle flattened and projecting in the space of the aperture, being separated from the fold by a deep insinuation; the outer lip is generally somewhat produced anteriorly, the anterior canal being distinct. The shells belonging to this genus generally are of larger size, than other RINGICULINÆ. The *Auricula decurtata*, Sow., from the Alpine Gosau deposits is, as stated by Meek, a species of this genus, but *Avellana Royana*, d'Orb., does not belong to it. In fact I do not know any other species referrible to this genus, except three from our cretaceous deposits, being remarkable for their large size.

21. ? *Stomatodon*, Seeley, 1861 (Ann. mag. nat. hist., VII, p. 293), a name given to the cast of a shell from the Cambridge Greensand; the species *St. politus*

* The name *Avellana* on the plates 168 and 169 of the 2nd Volume of d'Orbigny's Paléontologie française was published about the end of 1842, the text subsequently, I think, in the next year. (See Bronn's Jahrbuch for 1842).

resembles in general form a *Ringicula* or *Ringinella*, but the two columellar folds are placed in the middle of the lip, resembling those of several *Auriculidæ*, like *Ophicardelus* or *Leuconia*. The aperture is semi-circular, but as in all casts of the *ringiculinæ* entire. The only probability of this genus (if at all distinct from those previously mentioned), belonging to the present sub-family, is the presence of thickened margins of its aperture, which from the impressions they have left on the cast are supposed to exist on the perfect shell; this, however, only allows a conclusion to be made as to the internal, not the external, thickening.

22. A distinct type of the *ringiculinæ* may be represented by the *Avellana ventricosa*, Binkhorst (Gast. et ceph. craie de Limbourg, etc., 1861, p. 63, pl. 5^{a2}, fig. 5, and pl. 5^{a3}, fig. 12), but the shell is only known from a cast; this one in general form resembles that of an *Avellana* with a short obtuse spire, the surface being spirally sulcated, the aperture elongated, almost throughout equally narrow, and internally finely denticulated on both the inner and the outer lips; this denticulation extremely resembles that of a *Cypræa*, and as there is no trace of the external shell perceptible, it is impossible to ascertain whether the species belongs to the *ringiculinæ* or to the *Cypræidæ*.

At last I may mention the name *Aptycha*, which was proposed by Meek (American Journ., XXXV, p. 93) for *Tornatella labiosa* of Forbes, and which is a true *Ringicula*, as will be shown from the description and figure of Forbes' original specimen. The name *Aptycha* must, therefore, be struck out of the list of genera altogether, unless some one be so fortunate as to discover a species with thickened lips and no columellar folds, or thickened edge of the inner lip.

The cretaceous species of the *Actæonidæ* are rather numerous, but not many of them are known in a desirable state of preservation, and, therefore, their correct generic determination must for the present remain uncertain. The determination of cast specimens is almost never to be depended upon, because the external thickenings of the shell so very much alter its form. The following genera appear to be represented.

Actæonina.

Pictet and Campiche (Mat. p. l. Pal. Suisse, III Ser., p. 186, etc.) mention five species of this genus, all from the lower cretaceous beds;

1-5. *Act. Dupiniana*, d'Orb., sp., *Act. Nerei*, P. and C. (d'Orb.?), *Act. Icaunensis*, Cotteau, *Act. Renevieri* and *Chavannesi*, P. and C.

6. *Actæonina Texana*, Römer, sp. (Kreidegeb. von Texas, p. 40, pl. 4, fig. 2) was described as a doubtful *Eulima*, and it can only doubtfully be placed in this genus, though it more probably belongs to it.

7-8. *Act.? pupoides* and *Californica* are described by Gabb in the Palæont. of Calif., I, pp. 113 and 114. They both appear rather doubtful, not having been as yet found in good preservation.

9. *Act. volgensis*, Eichwald (Leth. Rossica, XI, livr., 1867, p. 831), is said to occur in the Neocomien clay of Bessonowo.

10-11. *Act. obesa* et *columnaris* are two new species from our South Indian cretaceous deposits; the descriptions will be given subsequently.

12. *Phasianella lineolata*, Reuss (Böhm. Kreidef., I, 1846, p. 49, pl. 10, fig. 19) could be referred to *Actæonina*, or some of the allied genera with more elevated spire, like *(Auriculina)*.

13. *Bulla Orbigniyi*, Guéranger, Album. pal. 1867, pl. 14, fig. 35, is also probably an *Actæonina*.

14. *Cylindrites brevis*, Gabb (Palæont. Calif., I, p. 115, non *idem* Morr. and Lyc.) is the only cretaceous species described under that generic name, though I do not think that it belongs to the genus *Cylindrites*; it is more like an *Actæon*, or it may be an imperfect *Cynulia*. If the shell has no thickened lip and is smooth it must form the type of a new genus. We possess from our South Indian cretaceous rocks an imperfect specimen of a shell, which much resembles this supposed *Cylindrites*; traces of the shell-surface show that the structure was thin, and there are only striæ of growth perceptible. The termination of the columella is twisted, and above it, nearly at the middle of the inner lip, there is a distinct fold; the lip itself not being remarkably thickened. In consequence of the imperfectness of the only specimen which is from a brownish, siliceous sandstone west of Kurribiem, I am compelled to leave this interesting fossil undetermined, until better materials have been procured.

Bullina, Fér.

15-16. *Bullina (Tornatina) Jaccardi* and *Urgonensis*, Pictet et Camp. (Paléont. Suisse, III Ser., pp. 176-177).

17. *Bullina tenuistriata*, Cotteau, Moll. foss. de l'Yonne, p. 47.

17 a. *Conus cylindraceus*, Geinitz, appears to be a *Bullina*, judging from the figure given by Reuss in his Böhm. Kreidef., 1846, I, pl. 11, fig. 19. The *Volvaria tenuis*, Reuss *(ibid.*, p. 50) is probably the same or a very closely allied species. Reuss questions the existence of three columellar folds.

18. *Bulla Archiaci*, Bosq. (Foss. fauna en flora van Limburg, in Staring's Bodem van Nederland, II deel) is, from specimens received through Mr. Bosquet himself, a true *Bullina*.

19-20. *Bullina alternata* and *cretacea* will be described from our South Indian cretaceous deposits; they both have an immersed, but distinct spire.

Of the genus *Actæon*, including *Solidula* or the biplicated forms, 24 species from European cretaceous deposits are quoted by Pictet and Campiche (l. cit., pp. 193-195).

21. *Actæon marginata*, Desh., sp., is the only known cretaceous species which partially resembles the form named by A. Adams *Myonia*, but it may be an imperfect *Cinulia*.

22. *A. marullensis*, d'Orb. *(A. affinis*, in Pal. franç.) is a *Ringinella* with slightly thickened outer lip; if specimens are not fully grown the lip is only obtuse.

23. *A. albensis*, d'Orb., is also a *Ringinella* with a slightly thickened lip.

24. *A. ringens*, d'Orb., a species with the aperture anteriorly truncated, the inner lip thick with one anterior and three posterior folds; this probably represents a distinct type of a genus or at least of a sub-genus.

25-26. *A. scalaris* and *brevis*, d'Orb., are almost only known by name.

27. *A. Astieriana*, d'Orb., probably a true *Actæon*.

28. *A. Moutoniana*, d'Orb., a very short form.

29. *A. Forbesiana*, d'Orb., is a true *Actæon*.

30. *A. subalbensis*, d'Orb. *(A. albensis* apud Forbes), is doubtful.

31. *A. Vibreyana*, d'Orb., belongs to the same type as *A. ringens*.

32. *A. affinis*, Sow., is a *Ringinella*, allied to *R. lacryma*.

33. *Tornatella elongata*, Sow., is probably also a *Ringinella*.

34. *A. elongata*, Coquand, is an elongated species with five folds, probably of the same type as *A. ringens* and *Vibreyana* of d'Orbigny.

35. *A. ovum*, Dujardin, sp., is most likely a young shell of a *Cinulia* (as restricted) or an *Euptycha*.

36. *A. subsulcatus*, d'Orb. *(Auric. sulcata*, Dujardin) appears to be only an imperfect specimen of an *Avellana*.

37. (?) *A. Reussii*, d'Orb. *(A. elongatus*, Rss.) is by no means so very different from the original *A. elongatus* of Sowerby, and most likely identical with it, being a species of *Ringinella*.

A. lineolatus, d'Orb. = *Phasianella id.*, Reuss, has been already mentioned in *Actæonina*. Until it has been ascertained that the species possesses a columellar plait, it cannot be correctly transferred to the genus *Actæon*.

38. *A. Müller*i, Bosq. (in Staring's Bodem van Limburg, II. deel) = *A. affinis* of Müller, belongs to the sub-generic group *Solidula*, having two columellar plaits.

39-43. *A. Doliolum, cylindraceus, bulliformis, acutissimus* and *coniformis* of Müller from the Senonien beds of Aachen are all acknowledged as distinct species by Bosquet (loc. cit.). In none of the species have the columellar folds been observed, but except the first, which appears to be a *Solidula*, all the others may be species of *Actæon or Actæonina*.

44-45. *Tornatella Beaumonti* and *T. Charpentieri*, d'Archiac (Bull. Soc. Géol. France, 1854, XI, p. 219, pl. 4, figs. 4 and 5), are species of *Actæon*.

46. (?) *A. granulato-lineatum*, Binkhorst (Mong. Gast. et Ceph. 1861, p. 62, pl. 3, figs. 3-4). No folds have been observed on the columella, and the species may therefore prove to be an *Actæonina*, and is not improbably identical with *Act. acutissimus* of Müller.

47. *A. cinctus*, Binkh. *(ibidem*, 1861, p. 82, pl. 5 [a3], fig. 4, non *id.* Rouill.) may be also an *Actæonina*, resembling our *A. obesa*. On p. 83, loc. cit., Binkhorst mentions that the species is distinct from that described on "page 63, pl. III, fig. 3" under the name of *Actæon striato-punctata*, having evidently forgotten that the name applied there is *A. granulato-lineatum ! !*

48. *A. cinctus*, Rouill. (Eichw. Leth. ross., 1867, XI, livr., p. 827) is quoted from the "Neocomien supérieur de Khoroschówo." Eichwald mentions that M. Rouillier also figured an *Actæon elongatus*, Rouill., but it appears to be more probably a *Natica* than an *Actæon*. In the same work (p. 826) he mentions *A. Petschoræ* and *striatulus*, Keyserling, occurring in limestone, which may be of Neocomien age.

49. A. *Cenomanensis*, Guéranger (Album pal. de la Sarthe, 1867, pl. 91, figs. 16-17) belongs to the sub-genus *Solidula*.

50. *Actæon inornatus*, Guéranger, *ibid.*, pl. 13, fig. 31. In his Repert. paléont. the same author names a species *Act. bullatus*, but he does not give a figure of it in the Album.

51. *Tornatella pyrostoma*, Seeley (Ann. mag. nat. hist., VII, p. 292, pl. 11, fig. 21), from the Cambridge Greensand, only known from a cast, may belong to *Solidula*.

52-53. ? The *Phasianella formosa* and *striata* of Sowerby, in Trans. Geol. Soc., Lond., 2nd ser., IV, pl. 18, figs. 14 and 15), have more the appearance of *Actæon*, than of *Phasianella*.

No species have been reported from *Africa*, but a large number from *America*.

54. *A. ornata*, d'Orb., from Santa Fè.

55-65. *Solidula attenuata, biplicata, bullata,* lenta, Mortoni, Riddelli* and *subelliptica ; Actæon cretaceus, modicellus, ovoideus* and *texanus ;* see Meek's Check list of cret. foss. of N. America, 1864, p. 17.

66. *A. impressus*, Gabb (Pal. Calif. I, p. 142, pl. 21, fig. 106), is, as I have already stated, referred by Conrad to a new genus *Tornatellæa* (Check list eocene fossils of N. America, 1866, p. 9), but I much suspect that the species is only an imperfect *Ringicula*.

67. *Tornatellæa bella*, Conrad *(ibid.*, p. 9) is also from the same beds as the last, being considered of cretaceous age.

68. *Actæonema prisca*, Conrad *(ibid.)*, also from the same beds.

69-74. I shall note from the South Indian cretaceous deposits the following species, *Act. (Solidula) semen*, Forb., *A. (Solidula) pugilis*, n. sp., *A. seminatus*, n. sp., *A. turriculatus*, n. sp., *A. curculio*, Forb., and *A. junceus*, n. sp. The other species referred by Forbes and d'Orbigny to this genus were not correctly determined.

* Judging from the large size of the shell this could be an *Euptycha*.

Trochactæon.

Treating of the species of *Trochactæon (Actæonella,* olim) occurring in the deposits of the Alpine Gosau formation, I have mentioned the following species (Sitz. Akad., Wien, 1865, LII, pp. 515-519),

75-79. *Tr. (Actæonella) giganteus,* Sow.,* *Tr. Lamarkii,* Sow. sp., *Tr. conicus,* Münst. sp., *Tr. Lefebreanus* and *Tbucasianus,* d'Orb., the two last ones being known only from very short notes.

80. *Tr. Beyrichii,* Drescher, is probably the same which has formerly been mentioned by Geinitz, Reuss and others under the name of *Act. gigantea.*

81-82.? *Actæonella de Cristoforis,* Bass, and *Act. Reussi,* d'Orb., remain as yet doubtful species.

83-85. *Actæon Verneuilli,* Vill., *Actæonella fusiformis* and *oliviformis* of Coquand (Étage Aptien de l' Espagne, 1865, pp. 68-69) all belong to *Trochactæon.*

86-87. *Actæonella syriaca,* Conr., and *Act. Salomonis,* Frs. (Würtemb. Jahreshefte, XXIII, 1867, pp. 239 and 240) from the upper cretaceous beds of Palestine, also belong to *Trochactæon.*

88.? Judging from the statement *(ibid.,* p. 240) that the shell is flattened along the suture, I very much suspect that *Phasianella Absalonis,* Fraas, is probably also a species of the same genus.

Eichwald (Leth. ross., XI, livr., 1867, p. 830) mentions from Armenia an *Actæonella voluta,* Zek.; the original species of Zekeli is identical with *Trochactæon Lamarkii,* Sow. sp., but whether the Armenian one is the same remains to be ascertained. Eichwald also notices a few other species which will be mentioned hereafter. I have also compared in the Museum at Bonn the *Globiconcha coniformis,* Römer (Kreide. von Texas, p. 42, pl. 4, fig. 5), and it seems to me that the specimen shows some folds on the anterior portion of the columella; the specimen is badly preserved, but it is very probable that it is a cast of a *Trochactæon. Actæonella* sp., Binkhorst, Monog. Gast. et Ceph. craie, Limbg., p. 83, also most probably belongs to *Trochactæon.*

89-91. *Trochactæon truncatus, minutus* and *cylindraceus,* will be described from our South Indian cretaceous deposits.

92. Of the sub-family *APLUSTRINÆ* I may mention the doubtful *Bullopsis cretacea,* Con., from N. America, but it is possible that some of the species of *Actæonina* may be proved to belong to *Bullinula.* Some authors also refer *Globiconcha* of d'Orbigny to the family *ACTÆONIDÆ.* When lately at Paris I endeavoured to find out from d'Orbigny's collection in the Jardin des plantes the real signification of the name *Globiconcha,* but I turned away disappointed not being able to arrive at any reasonable conclusion. Not one of the specimens named by d'Orbigny is a perfect shell, but all imperfect casts, which can be very variously commented upon. Some of them have been shown to belong to *Cypræa;* others appeared to me to represent casts of *Tylostoma, Natica* and probably of *Cinulia.* There have been, however, by subsequent authors various globular shells described under the name of *Globiconcha,* and of these some very much resemble *Bullinula* and *Hydatina.*

93. *Bulla ornata,* Guéranger, Album pal. de la Sarthe, pl. 14, fig. 26, is evidently a *Bullinula.*

94. *Bullinula indica* from South India will be described subsequently.

The *RINGICULINÆ* are, as already mentioned, mostly cretaceous forms with the exception of *Ringicula,* which remained unaltered up to the present time, and a *Ringinella Mississippensis* quoted by Conrad from the oligocene beds of Vicksburg (Check list of eocene foss. of N. America, 1866, p. 28). I shall again first quote the species recorded under the name of *Avellana* by Pictet and Campiche in the Paléont. Suisse, 3 ser., pp, 209-219, and note afterwards any further additions.

Ringinella. Several species probably belonging to this genus have already been mentioned under *Actæon.*

95-102. *Avellana aptiensis, lacryma, valdensis, Clementina, inflata, alpina,*† *Mailleana* and *Hagenovi,* (see Pictet and Camp. Pal. Suisse, III. Ser.).

* (?) *Actæon giganteus?* Sow. in Staring's Bodem von Nederland, II. deel.

† *Tornatella pyrostoma* has already been mentioned under *Actæon.*

103-104. *Ring. sub-pellucida* and *acutispira,* Shumard, sp. (Meek, Check list cret. foss., N. America, 1864, p. 16).

105. *Ring. acuminata,* n. sp., will be described subsequently.

Cinulia, Gray (as restricted).

106. *Cinulia globulosa,* Desh., sp. I have already mentioned that *Actæon marginata,* Desh., and *A. ovum,* Duj., may be young shells belonging to this genus.

107. *Avellana Chilensis,* d'Orb. (Voy. Astr. Paléont., pl. 1, figs. 32-34) is a *Cinulia,* if the figure is correct and the columellar folds not obstructed by the rock.

108. *Cinulia (?) naticoides,* Gabb, sp. (Meek, Check list cret. foss., p. 16).

109. *Cinulia catenata,* Tate (Quart. Jour. Geol. Soc., Lond, 1865, XXI, p. 38, pl. 3, fig. 4) appears to be a true *Cinulia,* unless the specimen had the posterior portion of the lip imperfect, in which case it may belong to *Euptycha.*

Avellana, d'Orb. (as restricted).

110-127. *Av. sphæra, striata, obsoleta, incrassata, sub-incrassata, Hugardiana, Dupiniana, Baudoniana, ovula, ventricosa, cassis, Prevosti, varusensis, Rauliniana, Royana, Archiaciana, paradoxa, Humboldtii (vide* Pict. and Camp. l. cit., pp. 211-212). So far as good descriptions and figures of these species have been published they belong to *Avellana.*

128-129. *Avellana serrata* and *bistriata,* Gümbel (Bayer. Alpengebirge, etc., 1861, p. 572). The descriptions are not sufficient to determine the genus correctly.

130. *Avellana pygmæa,* Bosquet (Staring's Bodem von Nederland, IIde deel) only as yet known by name.

131. *Avellana gibba* (Binkhorst, Monog. Gast. et Ceph. craie de Limbg., 1861, p. 63, pl. 5^{a3}, fig. 4) is distinguished by a produced, pointed spire and rather smooth shell surface.

132. *Avell. ventricosa,* Binkh. (*ibid.,* pl. 5^{a2}, fig. 5) probably represents, as already stated, a new sub-generic type on account of the numerous, small teeth on the inner lip.

Guéranger named in his Repert. paléont. de la Sarthe, 1853, three species, *Avellana Cenomanensis, elongata* and *minima;* of these he identifies in his Album paléont. of 1867 the first with d'Orbigny's *A. cassis;* the second is a good species identical with one from our Indian deposits, but the third is not mentioned at all in the *Album;* perhaps the name applies to some young specimens of the other species.

133-135. *Cinulia (Avellana) concinna, pulchella* and *Texana,* from N. America, see Meek's Check list, cret. foss., 1864, p. 16.

136-138. *Cinulia obliqua, Mathewsonii* and *pinguis,* Gabb (in Pal. Calif. I, p. 111-112); the last named species is more probably a *Ringinella.*

139-142. *Avellana ampla, scrobiculata, sculptilis* and *elongata* will be described from our cretaceous deposits; the three first named are new, the last one has been lately figured by Guéranger in his Album paléont. de la Sarthe.

The genus *Ringicula* is not accepted by Pictet and Campiche as occurring in cretaceous deposits, though several species are found. The first has been described by Forbes from the cretaceous deposits of India as—

143. *Ringicula acuta* and has, without assigning any reason, been transferred by d'Orbigny to *Actæon* under the name of *A. subacutus* (vide *postea*).

144. *Ringicula labiosa* is the *Tornatella labiosa* of Forbes, for which Meek proposed the generic name *Aptycha* (vide *postea*).

145. *Ring. Verneuilli,* d'Arch. (Bull. Soc. Geol. France, XI, 1854, p. 218, pl. 4, fig. 3) correctly belongs to this genus.

146. (?) *Ring. pinguis,* Müller (Suppl. zur Monog. Petr. Aachener Kreidef., 1859, p. 22, pl. 8, fig. 15). The uppermost fold of the inner lip pointed out by Müller is not exactly a fold, but only the angular projection of the callous lip, it disappears internally. Judging from specimens received

through Mr. Bosquet, I strongly suspect that this species is not different from *R. Verneuilli* of d'Archiac; I am at least unable to trace any difference between those specimens and d'Archiac's figure.

147. *Ring. varia,* Gabb (Pal. Calif. I, p. 112).

Euptycha.

148. *Auricula (Avellana) decurtata,* Sow., from the Alpine Gosau formation is the only European species of *Euptycha* as yet known.

149-151. *Euptycha globata, larvata* and *oviformis,* occur in the cretaceous beds of Sth. India and will be described subsequently.

Thus viewing the large number of cretaceous *ACTÆONIDÆ,* it is seen that many of the so called species require further examination and correction, but even with the existing deficiencies the importance of the group for the study of cretaceous fossils cannot be denied.

The *ACTÆONINÆ* are the first known to appear in the palæozoic deposits, and are more numerous in the jurassic than in the cretaceous period. The *APLUSTRINÆ* are always very scarce; there are only a few jurassic and cretaceous species known; the recent species are also very local. The *RINGICULINÆ* first appear in the cretaceous period as a distinct type; when young they very much resemble *Actæon.* The largest number of the specific and generic forms appear to become again extinct in the cretaceous period, only one, *Ringicula,* being known recent, though by no means a common shell.

XCVIII. ACTÆONINA, *d'Orbigny,* 1850.

1. ACTÆONINA OBESA, *Stoliczka,* Pl. XXVIII, Fig. 31.

Act. testa elongata, spira turrita; anfractibus sub-convexis, ultimo maximo, sub-inflato; superficie spiraliter punctato-sulcata, sulcis circiter senis, nonnullis posticis prope suturam sitis et alteris anticis approximatis, fortioribus et tenuioribus alternantibus; apertura amplissima, labio antice ad marginem incrassato, labro tenui.

Spiral angle about 50°; sutural angle about 8°.
Approximate height of spire : total of shell (considered as 1·00) ... 0·32.
Width of last whorl : approximate height of shell („ „ „) ... 0·52.

We only possess fragments of this shell, but the last whorl is nearly perfect at the aperture, which is that of a true *Actæonina.* The inner lip is anteriorly distinctly flattened, but without a trace of any fold. The whorls are slightly convex. The surface is marked all over with punctated impressed lines, some of which are placed near the suture, and others near the anterior termination, being rather more closely arranged than those in the middle, and alternating in strength.

Locality.—Comarapolliam, in soft, coarse grained, siliceous sandstone; apparently very rare.

Formation.—Arrialoor group.

2. Actæonina columnaris, *Stoliczka*, Pl. XXVIII, Fig. 26.

Act. testa cylindracea, spira producta, attenuata, ultimo anfractu breviore; suturis paulum impressis; superficie lineis impressis, numerosis, crasse-punctatis notata; apertura perlonga, angusta, postice acuminata, antice subrotundata, latiore; labio prope recto, edentulo, antice paulo incrassato.

Spiral angle about 25°; sutural angle 10°.
Height of spire : total of shell ... (considered as 1·00) ... ... 0·40.
Width of last whorl : total of shell („ „ „) ... ... 0·28.

This species is distinguished by its elongated, cylindrical form, having a rather lengthened attenuated spire, composed of from four to five flattened volutions, being impressed at the suture. The last whorl is somewhat higher than the spire; the aperture very narrow, pointed posteriorly, broader and rounded anteriorly, the outer lip thin, the inner lip slightly thickened and without any folds; the columella appears to be anteriorly very slightly truncated, but is not twisted. The entire surface of the shell is marked with coarsely punctated, spiral grooves, which are a little more distant at the middle of the last whorl.

There is no cretaceous species of *Actæonina* known which is equally cylindrical with the present one, but some large jurassic forms, like *A. Dormoisana* and *acuta*, d'Orb., belong to the same type.

Locality.—Pondicherry, in bluish sandstone.

Formation.—Valudayur group.

XCIX. BULLINA, *Férussac*, 1821.

1. Bullina alternata, *d'Orbigny*, sp., Pl. XXVII, Figs. 17-18.

1847. *Bulla alternata*, d'Orbigny, Voy. d'Astrolabe, Paléont., Pl. V, Figs. 1-5.

Bull. testa ovato-elongata, postice angustata et truncata, ad medium sub-inflata, antice paulo producta, angusta ac rotundata, anfractibus postice ad marginem sub-canaliculatis, spira immersa; superficie undique spiraliter punctato-striata, striis anterioribus ceteris aliquantum fortioribus; apertura lineari, postice angusta, antice dilatata; labio antice paululum torto, fissura distincta instructo.

Width of shell : its height (considered as 1·00) ... ... 0·49.

The last whorl envelopes all the previous ones, the spire being immersed, though portions of the flattened, or slightly canaliculated, posterior edge of the inner whorls remain traceable; the shell is rather inflated below the middle and anteriorly somewhat attenuated and rounded; the inner lip is very obscurely twisted, but there is a distinct fissure present, and occasionally the anterior portion of the last whorl is at the inner lip quite detached from the previous one. The spiral striation is generally somewhat more distinct on the anterior than on the posterior portion of the shell, but I have never observed it so strongly marked as represented in d'Orbigny's figure; the striæ of growth are very minute.

Localities.—Near Garudamungalum and near Veraghoor, in sandstone; not very rare.

Formation.—Trichinopoly group.

2. Bullina cretacea, *d'Orbigny*, sp., Pl. XXVII, Fig. 19.

1847. *Bulla cretacea*, d'Orbigny, Voy. d'Astrolabe, Paléont., Pl. III, Figs. 18-21; (non *idem.*, Müller, 1851).

Bull. testa elongata, cylindracea, postice paululum angustiore quam antice, striis incrementi tenuibus, nonnunquam subrugosis notata, spiraliter undique striata, striis obsolete punctatis; anfractibus ad marginem posteriorem rotundatis, spira aliquantum immersa, apice paulo incrassato; apertura longissima, recta, angustissima, antice latiori, labro ad marginem tenui, labio antice paululum incrassato, vix torto.

Width of shell : its height (considered as 1·00) ... ... 0·47.

This species is principally characterized by its prolonged cylindrical shape, being posteriorly only a little narrower than anteriorly, and by the whorls being rounded at the posterior edge; the spire is somewhat immersed, but distinctly traceable, the suture being impressed and the apex thickened. The entire surface of the shell is covered with very numerous, obsoletely punctated, fine spiral furrows, and with transverse striæ of growth, which are near the aperture and posteriorly generally somewhat more distinct than they are anteriorly, though I have never observed such a strong difference as exhibited in d'Orbigny's original figure.

The aperture is linear, straight, posteriorly very narrow, anteriorly expanded and rounded; the outer lip is sharp at the edge and the inner lip anteriorly somewhat thickened, reflexed, and internally very slightly twisted.

Müller's *Bulla (Cylichna) cretacea** from the Aachen Senonien deposits is distinct from our species, being anteriorly much narrower. Müller subsequently† considers d'Archiac's *Bulla ovoides* as identical with his *B. cretacea*, though d'Archiac's figure evidently represents a shell somewhat stouter, or at least somewhat more inflated in the middle. Bosquet proposed for Müller's *B. cretacea* the name *B. Mülleri*. D'Archiac's *Bulla Palassoui* very much resembles in form our Indian *Bullina cretacea*, but specimens which we have received from Mr. Bosquet show that the former species is a true *Cylichna*.

Locality.—Garudamungalum, in light bluish calcareous sandstone; very rare.

Formation.—Trichinopoly group.

* Petræf. Aachner Kreidef., pt. II, 1851, p. 7, pl. 3, fig. 4.

† *Ibid.* Supplement, 1859, p. 20.

C. ACTÆON, *Montfort*, 1810.

1. Actæon (Solidula) semen, *Forbes*, sp. Pl. XXVII, Figs. 5, 6, 7.

1846. *Tornatella semen*, Forbes, Trans. Geol. Soc., Lond., VII, p. 135.
1850. *Actæon id.*, d'Orb., Prod. II, p. 219;—*idem* auctorum.

Act. testa crassiuscula, ovato-elongata, anfractibus sub-convexis, postice ad suturam obtuse abbreviatis, spira turriculata, ultimo anfractu cylindraceo; superficie lirata, striis incrementi minutissimis notata, liris latis, levigatis, sulcis multum angustioribus, postice crasse punctatis; apertura ovata, labro ad marginem tenui, intus brevi-sulcato, antice late, haud profunde insinuato, labio tenui; columella antice duabus plicis obliquis instructa.

Spiral angle 50°-65°; sutural angle 8°-10°.

	Fig. 5.	Fig. 6.	Fig. 7.
Height of spire : total of shell (consd. as 1·00) ...	0·40.	0·52.	0·40.
Width of last whorl : height of shell (consd. as 1·00)...	0·48.	0·49.	0·59.

The characteristic distinctions of this species are the rather solid structure of the shell, with deeply punctated and narrow spiral sulcations, the produced spire and the cylindrical shape of the last volution, which is, like all the previous ones, truncated posteriorly along the suture. The columellar folds are rather anterior and somewhat distant from each other, though they approximate much more at the lip of a perfect specimen. The two specimens represented under figures 6 and 7 are from the white limestone of Ninnyoor; they appear to have the last whorl somewhat shorter in proportion to the height of the shell and less cylindrical in shape, but I do not think that these differences are sufficient to warrant specific distinction.

This is the species described by Prof. Forbes under the above name, though he has figured a different shell for it, *Act. seminatus*, n. sp.

In form it is closely allied to *Act. affinis*, Sow., from Blackdown, but this last one is said to have a posterior fold on the inner lip, though I have not been able to detect it in several of the Blackdown specimens.

Localities.—Garudamungalum, in bluish sandstone, common; Ninnyoor, in whitish limestone; very rare.

Formations.—Trichinopoly and Arrialoor groups.

2. Actæon (Solidula) pugilis, *Stoliczka*, Pl. XXVII, Figs. 8, 9.

Act. testa ovato-elongato, anfractibus numerosis, convexiusculis, postice ad suturam adpressis, sulcis angustis, undique puncturatis notatis composita, liris transversaliter striolatis; apertura angusta, columella antice oblique biplicata.

Spiral angle 60°-65°; sutural angle 6°-10°.

	Fig. 8.	Fig. 9.
Height of spire : total of shell (considered as 1·00)	0·39	0·41.
Width of shell : its height... („ „ „)	0·50	0·50.

The obtusely acuminate form of the spire and the greater convexity of the whorls, which are posteriorly at the sutures slightly contracted, but not truncated,

readily distinguish this species from *Act. turriculatus*, n. sp. The spiral sulcations also appear to be somewhat finer and the transverse striation of the ribbings, representing the striæ of growth, a little more distinct, than in the previous species.

Locality.—Comarapolliam, in whitish, siliceous, soft sandstone; very rare.

Formation.—Arrialoor group.

3. Actæon seminatus, *Stoliczka*, Pl. XXVII, Fig. 16; Pl. XXVIII, Fig. 18.

1846. *(Tornatella semen)* Forbes in Trans. Geol. Soc., Lond., VII, Pl. 15, Fig. 2: non *idem*, p. 135).

Act. testa ovata, tenui, polita, spira sub-turrita, apice acuminata; anfractibus convexiusculis, postice rotundate truncatis, duabus seu tribus striis punctatis, approximatis instructis; ultimo anfractu sub-inflato, spira altiore, distanter spiraliter striato-punctato; apertura ovata, columella uniplicata.

Spiral angle 80°; sutural angle 6°.				
Height of spire : total of shell	... (considered as 1·00)	...	...	0·40.
Width of last whorl : height of shell („ „ „)		...	...	0·65.

Shell oval, consisting of five or six, slightly convex, and posteriorly subtruncate whorls, which are near the suture marked with two or three spiral, punctated lines; the last whorl is higher than the spire and ornamented with similarly punctated, rather distant spiral lines; the columella has one fold.

The thick ovate form and the posteriorly truncated whorls distinguish this species from others. Forbes gave a figure of it under the name of *T. semen*, although his description is taken from another specimen, both being represented in Messrs. Cunliffe and Kay's collection, presented to the Geological Society of London.

Locality.—Garudamungalum, in bluish, calcareous sandstone; not rare.

Formation.—Trichinopoly group.

4. Actæon turriculatus, *Stoliczka*, Pl. XXVII, Figs. 10-11; Pl. XXVIII, Fig. 19.

Act. testa ovato-elongata, crassiuscula, polita, spira elevata, acuminata, anfractibus convexiusculis, postice ad suturam paulo contractis, adpressis, spiraliter numerose punctato-striatis; ultimo anfractu spira altiore, similariter punctato-striato, striis fortioribus distantibus, una vel duabus tenuioribus interpositis alternantibus; apertura ovata, postice acuminata, antice rotundata, labro intus levi, ad marginem acuto, antice late ac leviter effuso, labio postice tenuissimo, antice crassiore, plica unica, torta, obliqua instructo.

Spiral angle 50°-60°; sutural angle 5°.				
Height of the spire : total of shell	... (considered as 1·00)	...		0·39.
Width of last whorl : height of shell ... („ „ „)		...		0·50.

This species is distinguished from *Act. seminatus*, n. sp., by its more elongated form, and by having the whorls posteriorly not truncated, but slightly contracted and adpressed at the suture. The spiral punctated lines are posteriorly very

numerous, fine and closely set, then follows a broad band generally without any striæ, after which the former again appear, being, however, more distant, and on the last whorl of well preserved specimens each stronger one alternating with one or two finer ones.

Locality.—Garudamungalum, in bluish, calcareous sandstone; not rare.

Formation.—Trichinopoly group.

5. Actæon curculio, *Forbes*, sp., Pl. XXVII, Figs. 12-13.

1846. *Tornatella curculio*, Forbes, Trans. Geol. Soc., Lond., VII, p. 135, Pl. XII, Fig. 25.
1850. „ „ *idem*, d'Orbigny, Pictet, et alii.

Act. testa elongata, cylindracea, spira acuminata, anfractibus sub-convexis, postice plus minusve conspicuiter truncatis, undique sulcis profundis, angustis obsolete punctatis notatis; apertura longissima, angusta, labio intus sulcato, labro antice plica obliqua instructo.

Spiral angle 48°-50;° sutural angle 6°.
Height of spire : total of shell (considered as 1·00) ... ... 0·39.
Width of last whorl : height of shell („ „ „) ... ... 0·44.

A large, elongated shell, with a prominent pointed spire and a cylindrical last volution; along the suture the whorls are posteriorly more or less truncated; the entire surface is covered with deep, obsoletely punctuated, spiral sulcations, being separated by broader flat ridges. The aperture is very long, posteriorly narrow and anteriorly rounded, the outer lip internally sulcated and the inner lip anteriorly provided with an oblique fold, which is rather small in proportion to the large size of the shell.

Locality.—Comarapolliam, in soft, coarsely grained sandstone; rare.

Formation.—Arrialoor group.

6. Actæon junceus, *Stoliczka*, Pl. XXVII, Fig. 15.

Act. testa elongata, spira turriculata, apice acuminato; anfractibus circiter senis, postice ad suturam truncatis, ultimo cylindraceo, spiram in altitudine fere æquante; superficie undique spiraliter punctato-striata, striis postice prope suturam sitis tenuioribus et magis approximatis quam ceteris; apertura postice acuta, antice rotundata, labro intus levi, labio antice uni-plicato.

Spiral angle 48°; sutural angle 6°.
Height of spire : total of shell ... (considered as 1·00) ... ... 0·43.
Width of last whorl : height of shell („ „ „) ... .. 0·41.

Shell very elongated and comparatively narrow, composed of six or seven, very slightly convex volutions, being posteriorly truncated along the suture, and having the last whorl little higher than the spire; the entire surface is marked with spiral, punctated impressed lines, the posterior ones being finer and placed rather more closely to each other than the rest. The aperture is narrow, posteriorly pointed,

anteriorly rounded; the outer lip sharp at the edge, internally smooth, anteriorly broadly effuse; the inner lip of moderate thickness, smooth, anteriorly with a slight, twisted fold.

This species is principally characterized by its elongated and thin form; it closely resembles in this point the Neocomien *Actæon Dupiniana*, d'Orb. (Pal. franç. terr. cret., II, pl. 167, figs. 1-3) which is said to have no columellar folds, and was therefore transferred to the genus *Actæonina* (or *Orthostoma)*.

Locality.—N. of Odium, in yellowish and dark brown earthy limestone; very rare.

Formation.—Ootatoor group.

CI. TROCHACTÆON, *Meek*, 1863.

On Plate XIV the species of this genus are noted under the name *Actæonella.*

1. Trochactæon truncatus, *Stoliczka*, Pl. XIV, Fig. 8.

Trochact. testa cylindracea multi-spirata, involuta, levigata, supra truncata et lente excavata, partem superiorem omnium anfractuum exhibente; anfractibus numerosis, angustissimis, labio antice plicis tribus, acutis, subæqualibus, sub-obliquis instructo.

Approximate width of shell : its height (considered as 1·00) ... ... 0·54.

A sub-cylindrical shell composed of numerous, very narrow volutions, being anteriorly somewhat thinner, and at the apex truncate or rather excavated, so as to expose all the upper flat top-portions of the whorls; the three columellar folds are very sharp and not very oblique.

The only known form which is allied to our fossil is *Troch. (Actæonella) fusiformis*, Coq., being, however, much narrower at the truncate apex and forming in this way a passage to *Actæonella* (Monog. Étage Aptien de l'Espagne, 1865, p. 69, pl. 3, fig. 7).

Locality.—Shillagoody, in a light brown, rather siliceous sandstone; apparently very rare.

Formation.—Arrialoor group.

2. Trochactæon minutus, *Stoliczka*, Pl. XIV, Fig. 9; Pl. XXVIII, Fig. 17.

Trochact. testa cylindraceo-elongata, levigata, spira brevi, obtuse acuminata, antice paulo attenuata; anfractibus angustissimis, numerosissimis, postice anguste applanatis et prope suturam linea impressa notatis; labio tenui, antice incrassato, oblique triplicato.

Spiral angle 95°.
Height of spire : total of shell ... (considered as 1·00) ... ... 0·20.
Width of last whorl : height of shell („ „ „) ... ... 0·40.

This species has usually a broadly pointed, more or less short spire, consisting of numerous volutions, which are posteriorly obliquely flattened and closely marked

at the suture with a distinct impressed line. The shell is smooth, rather elongated and anteriorly somewhat attenuated, being by these characters easily distinguished from the next species, with which it has been previously confounded.

Locality.—Comarapolliam, in softish, rather coarse sandstone with siliceous grains; rare.

Formation.—Arrialoor group.

3. Trochactæon cylindraceus, *Stoliczka*, Pl. XIV, Figs. 10-14.

Trochact. testa ovato-elongata, cylindracea, levigata, antice atque postice paulo attenuata, spira plus minusve prominente, obtusiuscula; anfractibus angustis, postice oblique et anguste applanatis, deinde subcarinatis; striis incrementi in superficie ultimi anfractus lente curvatis, apertura longa, postice angustissima, antice latiore ac rotundata; labro ad marginem acutiusculo, levigato, antice oblique late ac lentissime effuso; labio levissimo, postice paulo incrassato, antice triplicato: plica antica tenuissima, postica crassissima.

Spiral angle 75°-90°.
Height of spire : total of shell (considered as 1·00) ... ... 0·25-0·36.
Width of last whorl : height of shell (considered as 1·00)... ... 0·44-0·55.

This species is closely allied to several European forms, like some varieties of *Trochact. giganteus* and especially the *Trochact. Lamarckii*, Sow. sp.; but among several hundreds of specimens which we possess, and which were obtained from various distant localities, I find that the cylindrical, anteriorly and posteriorly almost equally obtusely attenuated form of the shell appears to be a characteristic distinction, while in all the other species the whorls are posteriorly perceptibly more tumid than they are anteriorly.

The slightly curved fine striæ of growth can be generally clearly traced on the last volution. The aperture is anteriorly very slightly effuse, and the inner lips thickened and anteriorly provided with three oblique folds, of which the posterior one is the strongest.

Worn specimens are often found in two very different conditions; either only the posterior edge of the whorls has been corroded, and in such case the spire appears much more raised, than is usual in well preserved shells; when, however, the upper corrosion has far advanced the spire becomes very much shortened, and thus the appearance of the shell is considerably altered.

Perfect specimens even of small size are always of a distinct cylindrical shape, but those specimens which represent internal parts or fragments of larger ones appear sometimes considerably attenuated in front (see Pl. XIV, Fig. 10). This is, I believe, produced by the anterior portion of the shell being more absorbed or dissolved away, than the posterior; it is on this account that the anterior folds are often difficultly traceable in such fragmentary specimens; in fact fragments may be found in which the two anterior folds have almost entirely disappeared.*

* See previous notes on the genus *Trochactæon*.

Casts are always attenuated in front, and show near the anterior termination of the last whorl a broad and shallow furrow, as usual in species of *Trochactæon*.

Localities.—Kolakonuttom, S. W. of Koloture, S. of Serdamungalum, S. E. of Parchairy, near Andoor, etc.; mostly in a coarse grained, light brown, calcareous and siliceous sandstone; very common.

Formation.—Ootatoor and Trichinopoly groups; the first named locality refers to the former group; the species is here, however, very abundant, while rather rare at the other localities (see Blanford's Report, Mem. Geol. Surv., India, vol. IV, p. 88).

CII. BULLINULA, *Beck*, 1840.

1. Bullinula obtusiuscula, *Stoliczka*, Pl. XXVII, Fig. 14, and Pl. XXVIII, Fig. 25.

Bull. testa sub-ovata, spira subturrita, sæpissime irregulariter torta; apice mammillato, applanato, levi; anfractibus convexis, ultimo maximo, postice inflato, antice attenuato; superficie spiraliter costellata; apertura perlonga, postice acuminata, antice producta et effusa, labro tenui, labio moderate calloso, spiram partim tegente, columella crassa, cortorta, antice oblique truncata.

Spiral angle approximately 74°.
Height of spire : total of shell ... (considered as 1·00) ... ... 0·24.
Width of last whorl : height of shell („ „ „) ... ... 0·62.

The spire is in this species very remarkably formed; the apex being flattened, terminating in a pointed ridge; the two first whorls are inflated and quite smooth, the next finely spirally striated and convex, and the last whorl, which is much higher than the spire, is strongly inflated posteriorly and attenuated anteriorly; the surface being covered with numerous, smooth ridges, only crossed by very fine, slightly bent striæ of growth. The aperture characterizes this species as a true *Bullinula*, being pointed posteriorly, produced and effuse anteriorly; the columellar lip is thick, twisted, and obliquely truncate in front.

The species in general form much resembles the recent *Bull. Bruguieri*.

Localities.—Arrialoor, in softish sandstone; Pondicherry, in grey calcareous sandstone; rare.

Formation.—Arrialoor group.

CIII. AVELLANA, *d'Orbigny*, 1842.

1. Avellana ampla, *Stoliczka*, Pl. XXVI, Fig. 8; Pl. XXVIII, Fig. 20.

Avell. testa rotundata, globosa, spira moderate elevata; apice acuminato; anfractibus convexis, postice ad suturam paulo constrictis, adpressis, spiraliter striatis: striis tenuissimis, acutis, duabus alternatim approximatis, interstitiis transversaliter striolatis; apertura lata, postice anguste subcanaliculata, antice sub-obtusa; labro extus moderate varicoso, prope terminationem posteriorem sub-angulato, lateraliter

fere recto, antice subtruncato, late effuso, intus breviter plicato; labio crasso, postice obsolete–, ante medium atque ad terminationem anteriorem valde–, plicato: plica antica obliqua, longitudinaliter subfurcata; canali angustissimo, profundo.

Spiral angle 100°; sutural angle 8-10°.
Height of spire : total of shell (considered as 1·00) ... ... 0·27.
Width of shell : its height („ „ „) ... . 0·80.

Shell strongly globose, spire somewhat produced and pointed, whorls convex, somewhat contracted at the suture, the last almost evenly rounded; surface marked with numerous, fine spiral striæ, two of which are always close to each other and separated from the next pair by a little broader sulcation than that between themselves; the sulci are, as usual, transversally striated; aperture large, posteriorly pointed, anteriorly obtuse; outer lip moderately thickened externally, near the posterior termination somewhat angular, anteriorly obtuse and broadly effuse, internally provided with short folds: inner lip thick, posteriorly slightly angular, in front of the middle portion and at the anterior termination strongly plicated, the anterior fold being oblique and furrowed longitudinally; canal oblique, very narrow, but deep.

Locality.—N. W. of Veraghoor, in a coarse grained, soft, yellowish and whitish sandstone; not common.

Formation.—Trichinopoly group.

2. Avellana scrobiculata, *Stoliczka*, Pl. XXVI, Fig. 9; Pl. XXVIII, Fig. 21.

Avell. testa globulosa, transversaliter paulo expansa, spira brevissima, obtusiuscula seu apice acuminata; anfractibus convexiusculis, ad suturam paulo constrictis, ultimo paulo gibboso, superficie spiraliter anguste costulata: interstitiis excavatis, transversaliter striolatis seu punctatis; apertura postice angustissima, acuminata, antice rotundate terminanti, lata, marginibus crassis instructa; labro uniforme arcuato, intus denticulate plicato (vide figuram 9 b), labio ante medium et antice plicis crassis instructo; canali angusto, non profunde inciso.

Spiral angle 110°.
Height of spire : total of shell (considered as 1·00) ... ... 0·19.
Width of shell : its height ... („ „ „) ... ... 0·82.

This species is distinguished by its short spire, rather globose and roundish form, the spiral striæ or ribbings being all equally thick, and by the strongly thickened margins of the aperture, as compared with the size of the shell; the inner lip has a distinct posterior fold, but it is placed somewhat internally; the anterior denticulations of the outer lip are peculiarly strong.

In general form and ornamentation this species resembles *A. Hugardiana*, but differs from it in the disposition of the folds of the inner lip, if d'Orbigny's figure (Pal. franç., terr. cret., II, pl. 168, fig. 17) be perfectly correct in this point.

The species very seldom attains the usual size of *Avell. ampla*; most of our specimens (25) are not larger than the one of which a representation is given in Fig. 9 on Plate XXVI.

Localities.—Comarapolliam, E. of Kaudoor, E. of Veraghoor, Vylapaudy, in soft whitish sandstone; not rare.

Formation.—Arrialoor group.

3. Avellana sculptilis, *Stoliczka*, Pl. XXVII, Fig. 1; Pl. XXVIII, Fig. 22.

Avell. testa ovata, globulosa, spira moderate elevata, apice acuminata; anfractibus convexis, postice paulo constrictis, superficie liris sublævigatis, latis, interstitiis angustioribus, transversim striolatis seu punctatis separatis notata; apertura postice acuta, sub-canaliculata, marginibus moderate incrassatis; labro intus dentate-striolato, labio postice plica parva, ante medium una crassissima et antice altera obliqua, moderate elevata atque longitudinaliter furcata instructo; canali angusto, haud profundo.

Spiral angle 105°; sutural angle 8°-10°.
Height of the spire : total of shell (considered as 1·00) ... ... 0·30.
Width of the shell : its height ... („ „ „) ... ... 0·80.

This species closely resembles *A. ampla*, but is readily distinguished from it by a somewhat more slender form, stronger posterior tooth of the inner lip and broad spiral ribbings, being all of the same width and separated by narrower furrows. In perfectly well preserved shells the spiral ribbings are occasionally narrower than the furrows, but they are always very nearly of the same thickness among themselves.

Localities—N. E. of Karapaudy and Arrialoor; in softish, light coloured sandstone; not common.

Formation.—Arrialoor group.

4. Avellana elongata, *Guéranger*, Pl. XXVII, Fig. 2; Pl. XXVIII, Figs. 23-24.

1853. *Avellana elongata*, Guéranger, Repert. paléont. de la Sarthe, p. 30.
1867. „ „ „ Album pal., etc., Pl. IX, Fig. 19.

Avell. testa ovata; apice obtusiusculo; anfractibus convexis, superficie costulis spiralibus, acutis, interstitiis sæpissime latioribus transversaliter striolatis separatis ornatis; apertura ovali, postice angustata, sub-canaliculata; labro uniforme arcuato, incrassato, intus ad marginem denticulate-aut numerosissime-striolato, antice insinuato; labio moderate calloso, postice duabus plicis parviusculis, ante medium una crassissima, et antice altera obliqua, crassa et longitudinaliter furcata instructo; canali haud distincto, callositate labii multum obliterato.

Spiral angle 104°; sutural angle 6°-12°.
Height of the spire : total of shell (considered as 1·00) ... ... 0·21.
Width of the shell : its height ... („ „ „) ... ... 0·76.

The oval form of the shell, short and rather obtuse spire, the numerous equal denticulations of the outer lip, which is broadly insinuated anteriorly, the presence of two small posterior folds on the inner lip, and the ornamentation consisting

of sharp spiral ridges, separated by broader, transversally striated furrows, are the characteristic distinctions of this interesting species. When the surface of the shell is somewhat worn off the ridges become broader and the furrows respectively narrower.

Guéranger's photogram of this species is so characteristic that I do not hesitate to identify our fossil with it. The form of the shell, the short plications of the outer lip, and the disposition of the folds are perfectly identical. The last small fold on the inner lip is, it is true, not traceable in Guéranger's figure, but I have little doubt that it has only been obliterated by rock; besides in several of our own specimens this last fold is scarcely developed and always much more interiorly placed than any of the others. I think that Guéranger is perfectly right to consider this species as distinct from *Av. cassis*, d'Orb.; he procured his specimen in the "Gres verts" of Le Mans. *Avell. incrassata*, Sow., from Blackdown is very closely allied, but it is a somewhat less cylindrical species, the anterior fold is placed higher, and the spiral striation finer.

Localities.—N. and N. E. of Odium, N. E. of Shutanure, in yellowish, earthy and calcareous sandstone; not very common.

Formation.—Ootatoor group.

CIV. RINGINELLA, *d'Orbigny*, 1842.

1. Ringinella acuminata, *Stoliczka*, Pl. XXVII, Fig. 4.

Ring. testa subturrita, spira longa, acuminata; anfractibus octonis, primis duobus levigatis, ceteris spiraliter anguste liratis, liris sulcis punctatis, impressis separatis; apertura postice acuta, subcanaliculata; labro extus varicoso, labio crasso, prope medium intus valde angulato, antice insinuato atque plicis tribus obliquis, angustis instructo.

Spiral angle 45°; sutural angle 8°.
Height of spire : total of shell ... (considered as 1·00) ... ... 0·42.
Approximate width of shell : its height („ „ „) ... ... 0·58.

A very distinct species, characterized by its greatly produced, pointed spire, consisting of numerous, slightly convex volutions. The surface is marked with fine spiral, impressed and punctated lines; the margins of the aperture are strongly thickened, the outer one being, however, only partially preserved on our specimen, but the inner one is very thick, sharply angular at the middle, anteriorly insinuated and provided with three oblique folds.

Locality.—Comarapolliam, in softish, siliceous sandstone; very rare.

Formation.—Arrialoor group.

CV. RINGICULA, *Deshayes*, 1838.

1. Ringicula acuta, *Forbes*, Pl. XXVII, Fig. 3.

1846. *Ringicula ? acuta*, Forbes, Trans. Geol. Soc., London, VII, p. 136, Pl. XV, Fig. 3.
1850. *Acteon subacutus*, d'Orbigny, Prodrome II, p. 220; *idem.*, auctorum.

Ring. testa ovato-turrita, spira producta, acuminata; anfractibus quinis, subconvexis, sutura simplici, paulo impressa sejunctis, levigatis, ultimo spiraliter obsolete striato, striis ad terminationem anteriorem distinctioribus; labro varicoso, uniforme arcuato, extus levi, intus crenulato; labio valde incrassato, ad medium acute angulato, antice biplicato, plica antica in margine sita, obliqua; emarginatione angusta sed profunda.

Spiral angle 60°; sutural angle 6°-8°.
Height of spire : total of shell (considered as 1·00) ... ... 0·42.
Width of shell : its height ...(„ „ „) ... ... 0·56.

This is a typical species of *Ringicula* extremely resembling some recent ones, occurring at Ceylon and at Aden. The spire is rather prominent and pointed, the surface of the shell smooth and polished, having only some obsolete spiral striæ traceable on the last volution.

The aperture is narrow, pointed and sub-canaliculated posteriorly, truncated anteriorly, the outer lip being varicose, externally smooth, internally crenulated, and posteriorly extending to nearly three-fourths of the height of the previous whorl. The inner lip is rather thick, smooth, about the middle sharply angular, near to, and on, the anterior margin provided with strong oblique folds. Imperfect specimens very much resemble *Odostomia antiqua*, n. sp. (see p. 182), having only the posterior columellar fold preserved.

Forbes was perfectly correct in referring this species to *Ringicula*, while d'Orbigny placed it in the genus *Actæon* under a new specific name.

Locality.—Near Garudamungalum, in bluish calcareous sandstone; rare.

Formation.—Trichinopoly group.

2. Ringicula labiosa, *Forbes*, sp., Pl. XXVIII, Fig. 28 (original).

1846. *Tornatella labiosa*, Forbes, Trans. Geol. Soc., London, VII, p. 135, Pl. XII, Fig. 24.
1847. *Acteon unidentatus*, d'Orbigny, Voy. d'Astrolabe, Paléont., Pl. III, Figs. 22-25, *idem*, 1850, Prod. p. 219.
1850. *Avellana labiosa*, d'Orb., Prod. II, p. 220.
1863. *Aptycha labiosa*, Meek, Amer. Journ., Sc. and Arts, XXXV, p. 93.

Ring. testa ovata, spira subturrita, apice acuminato; superficie spiraliter lirata, apertura ampla, postice obtuse acuta et angulata, labro extus crassissimo, late varicoso, labio ad medium valde calloso, crenulato, antice tenuiori biplicato, plica antica brevi, in margine sita; emarginatione anteriori lata ac profunda.

Spiral angle 65°; sutural angle 2-10°.
Height of spire : total of shell (considered as 1·00) ... ... 0·28.
Width of shell : its height ... („ „ „) ... ... 0·65.

Shell with a produced, acuminate and somewhat irregularly twisted spire, surface narrowly spirally sulcated, one or two posterior sulci close to the suture being

broader than the rest; whorls slightly convex, the last being by far the largest. The aperture is oval, posteriorly obtusely pointed and canaliculated, anteriorly subtruncate; the outer lip is externally very broadly thickened and striated, internally it appears to be nearly smooth; the inner lip is very thick, especially about the middle, and has in front an unequally crenated edge, anteriorly it is thinner, insinuated, and provided with two folds, the first of which forms its anterior termination.

This interesting species was at first described by Forbes as a *Tornatella* with thick lips; a fragment of the same was figured by d'Orbigny as *Acteon unidentatus*, while the same author placed Forbes' species subsequently in the genus *Avellana*. Meek, as already mentioned, proposed for it the name *Aptycha*. Having lately examined Forbes' original specimen in the London Geol. Society's collection, I soon found after exposing the rock, covering the aperture of that original, that it belongs to *Ringicula*, forming by its large size and greatly thickened inner lip a transition to *Euptycha* of Meek. The unequal crenulation in front of the lip is very peculiar, though not quite unknown in recent and fossil species of the same genus.

Locality.—N. of Karapaudy, in whitish, soft sandstone; apparently very rare; we only possess two imperfect specimens, and I suspect the one described by Prof. Forbes was from the same or nearly the same locality, for the rock in which it is imbedded is pretty nearly the same as that of our specimens.

Formation.—Arrialoor group.

CVI. EUPTYCHA, *Meek*, 1863.

1. Euptycha globata, *Stoliczka*, Pl. XXVI, Fig. 5.

Eupt. testa regulariter ovato-globosa, spira brevi, obtusiuscula, prope quartam partem totius altitudinis occupante, in superficie sulcis spiralibus impressis, punctatis notata: liris interpositis latis, planis, transversaliter obsolete rugatis; apertura elongata, angusta, postice acute sub-canaliculata, antice oblique torta atque subrotundata, labio lamellam continuam prominentem formante, antice insinuato ac plica crassa, rotundata desinente; labro incrassato, antice insinuato; canali anteriori angustissimo.

Spiral angle 108°.
Height of spire : total of shell (considered as 1·00) ... ... 0·27.
Width of shell : its height ... („ „ „) ... ... 0·81.

This species is distinguished by its very regular, ovately globose form, having the surface marked with spiral, punctated impressed lines, which are separated by broad and flat ridges, being obsoletely transversally striated; about the middle and on the anterior portion of the last whorl these ridges are somewhat narrower than posteriorly. The aperture is posteriorly very narrow and sub-canaliculated, anteriorly roundish, the outer lip being anteriorly broadly insinuated; the inner lip forms a long, horizontally (or parallel to the axis of the shell) projecting rather thin plate, anteriorly it is deeply insinuated and terminates with a thick, roundish fold, in front of which there is a very narrow channel separating it from the outer lip.

The only species which bears some resemblance to our fossil is *Cinulia catenata*, Tate (Quart. Journ. Geol. Soc., Lond., 1865, XXI, p. 38, pl. 3, fig. 4) from the Upper Chalk of Ireland. The anterior fold of the inner lip of the Irish fossil corresponds with that of South India, but the posterior portion of the lip has not been observed in the former.

Locality.—The single but perfect specimen was found in the soft, glaukonitic sandstone near Olapaudy with *Fasciol. assimilis*, Stol., and others.

Formation.—Trichinopoly group, but close to the boundary of the Arrialoor.

2. Euptycha larvata, *Stoliczka*, Pl. XXVI, Fig. 6.

Eupt. testa ovata, subdepressa, in superficie sublevigata, spiraliter lineis impressis obsoletis notata, spira brevissima, obtusiuscula, circiter septimam partem totius altitudinis occupante; apertura perangusta, postice subcanaliculata; labio ad medium valde incrassato atque producto, deinde profunde insinuato, antice plica lata, in medio furcata terminanti; labro extus varicoso, intus calloso, antice tenuiori ac late insinuato, canali angustissimo.

Spiral angle 100°.

Height of spire :	total of shell (considered as 1·00)		0·14.
Width of shell :	its height ... („ „ „)		0·71.

Shell ovate, somewhat depressed from front to back, almost smooth, sometimes marked with few obsolete spiral lines; spire very short; aperture very narrow, posteriorly canaliculated; inner lip forming about the middle a thick callous plate obliquely projecting into the aperture, then deeply insinuated laterally, and anteriorly terminating with a very broad, flat, in the middle grooved, fold, in front of which there is a very narrow channel; outer lip internally and externally thickened and anteriorly insinuated.

The more elongated oval form, almost smooth surface, shortness of the spire, and median thickening of the inner lip easily distinguish this from both the previous and the following species.

Locality.—Comarapolliam, in light coloured or ferruginous sandstone; rare.

Formation.—Arrialoor group.

3. Euptycha oviformis, *Forbes, sp.*, Pl. XXVI, Fig. 7.

1846. *Nerita oviformis*, Forbes, Trans. Geol. Soc., Lond., VII, p. 122, Pl. XII, Fig. 13.

Eupt. testa ovato-globosa, in superficie striis spiralibus impressis notata, spira brevi, obtusa; apertura angustissima postice acute canaliculata; labio postice bituberculato, ad medium late producto, deinde profunde insinuato atque intus ad marginem unidentato, antice plica crassa, lata, in medio furcata terminanti; canali angusto, haud distincto; labro extus paulum, intus multum, incrassato, antice insinuato.

Spiral angle about 125°.

Height of spire :	total of shell (considered as 1·00)		0·20.
Width of shell :	its height ... („ „ „)		0·84.

The globose form, obtuse spire, distinct spiral striation, the posterior and anterior small tuberculations of the inner lip easily distinguish this species from

the previous one, to which it is allied as regards the form of the inner lip; the external thickening of the outer lip is not equally strong in this as it is in the last species.

Localities.—N. and S. of Serdamungalum and W. of Koloture, in whitish sandstone; rare.

Formation.—Trichinopoly group.

LIX. *Family,—BULLIDÆ.*

I shall include in this family beside the *Bullidæ*, as noted in H. and A. Adams' 'Genera' and partially emended by Gray in his 'Guide' of 1857, a portion of H. and A. Adams' family *Cylichnidæ*, and the *Amphisphyradæ* and part of the *Bullinadæ* of Gray.

All *Bullidæ* have a large body with an expanded mantle, partially covering the shell, the head is distinct, broad, the tentacles flat, fleshy, sometimes separated, but generally united into a posteriorly emarginated disk; the base of the foot is generally not very large, at least not much larger than the shell itself, but rather muscular. The presence or absence of the eyes, or their being more or less sunken in the fleshy substance of the tentacles, appears entirely to depend on the habits of life. Species or genera which are accustomed to burrow in sand do not require eyes, and are therefore generally blind, while those which live on coral-reefs or on seaweeds are provided with eyes. The dentition consists of numerous cross series, there is always one broad, finely denticulated central tooth present and a number of unequally or equally formed laterals.

The species are carnivorous, usually feeding on small bivalves which they swallow entire, crushing their shells with their strongly muscular gizzard, usually provided with horny or calcareous sides or plaits.

The shell is external, spiral, strongly involute or convolute, mostly ventricose, the last whorl enveloping all the previous ones. Aperture anteriorly widened, entire; no operculum.

The family could be divided into two divisions. On account of the difficulty in distinguishing the fossil species of *Cylichna* from *Haminea* and *Atys* and others I shall give a list of the cretaceous species subsequently after reviewing the genera.

a. *Sub-family,—CYLICHNINÆ.*

Animals with frontal disk strongly produced, posteriorly emarginated, mantle enclosed or partially covering the shell, which is distinguished by usually having anteriorly slight columellar folds. There is one central tooth, one large, hooked inner lateral on either side, and often five or six much smaller outer lateral ones.

1. *Retusa*, Brown, 1827 (H. and A. Adams, Gen. II, p. 11).

2. *Diaphana*, Brown, 1827 (*ibid.*, p. 12, *Amphisphyra*, Lovèn apud Gray, Philippi, &c.). Of both these genera the shells are very much alike, being

cylindrically globose, thin, narrower posteriorly, with a short flattened spire, more inflated anteriorly; with an enlarged aperture, an insinuated, thin and slightly twisted inner lip.

The shells of the former genus are said to differ by being more opaque and covered with an epidermis, while those of *Diaphana* are hyaline; there also are slight differences in the animal, and the former appears more to resemble *Cylichna* than *Diaphana*, still I think that further observations on the animals would be very valuable, so as to be certain of knowing whether the distinctions pointed out are really of generic difference; the shells do not appear to be generically different. I am not acquainted with any fossil species of the two genera.

3. *Cylichna*, Lovèn, 1846 (*ibid.*, p. 9). Shell solid, sub-cylindrical, *convolute*, posteriorly attenuated and truncated, anteriorly somewhat thickened, inner lip conspicuously thickened anteriorly, twisted or with a distinct fold.

H. and A. Adams state that the animal of *Cylichna* has not central teeth, but Lovèn figures the teeth of *C. alba* as consisting of one central, one pair of large inner lateral, and five small outer lateral. Meyer and Möbius (Hinterkiemer-der Kieler Bucht., p. 87) state that *Cy. truncata*, Montague, has no radula, but a gizzard with strong plates. Farther observations regarding the dentition are, therefore, very desirable. The recent species of *Cylichna** are rather numerous, and the genus is also numerously represented among fossil shells, though the species are occasionally very difficultly distinguished from those of *Bullina* (= *Tornatina*), when the latter have the spire flattened or even somewhat impressed. The species first appear in the Trias, and continue to occur through all the successive formations; those of the cretaceous beds will be mentioned subsequently.

4. *Volvula*, Adams, 1850 (*ibid.*, p. 14) is distinguished from *Cylichna* in having the posterior end not truncated, but pointed and produced; there is one distinct anterior columellar fold present. Several recent species have been described by A. Adams from the Japan seas in Ann. mag. nat. hist., 1862, IX, pp. 154-155. A. Adams dredged his specimens from 25-63 fathoms. Fossil species are not common in tertiary deposits, and the oldest known one is from the cretaceous.

5. *Actæonella*, d'Orbigny, 1842 (*Volvulina*, Stol., 1865, Sitzb. Akad., Wien, LII, p. 519). Shell *convolute*, like *Volvula*, attenuated at both ends, aperture linear, inner lip anteriorly thickened and provided with three folds. The shells which as yet are only known from cretaceous deposits mostly closely resemble the recent *Volvula*, differing from it merely by the presence of three columellar folds on the anterior portion of the inner lip. The animal of *Volvula* has as yet not been observed, but A. Adams, who examined all the known recent species, states that the shell is closely allied to that of *Cylichna*, and it is on this account that we not only retain the genus *Volvula* in the sub-family CYLICHNINÆ, but also add

* A large number of new Japanese species is described by A. Adams in Ann. mag. nat. hist., IX, 1862, p. 150, etc.

to it the fossil *Actæonella*. Some time ago I have suggested for the last named genus the name *Volvulina*, but as Meek's* proposition of the change in the generic names has priority I have adopted it here, though it would have been decidedly preferable to retain the name *Actæonella* for the species of the type *A. gigantea*, which was described and figured by d'Orbigny before the other species. As, however, the publication of all the species bears the same date, it of course rests with subsequent authors to retain any of those described as the type of the genus.

b. *Sub-family,—BULLINÆ.*

Shell convolute, ventricose, more or less covered by the lateral edges of the foot, aperture enlarged anteriorly and roundish, inner lip anteriorly sometimes conspicuously twisted.

The animal has the left side of the mantle generally more developed and thicker than the right one; the tentacles are at their bases united with the head-disk, but posteriorly they are generally distinct; the dentition consists of one squarish central tooth, and numerous similarly formed lateral ones; the following genera have to be placed in this sub-family;

6. *Bulla*, Klein, 1857 (H. and A. Adams, Gen. II, p. 15).
7. *Haminea*, Leach, 1847 (*ibid.*, p. 16).
8. *Atys*, Montfort, 1810 (*ibid.*, p. 20).

The shell of *Bulla* is thick and usually mottled on the surface, that of *Haminea* thin with distinct striæ of growth, and *Atys* is generally spirally sulcated towards the anterior and posterior ends of the shell, which is rather solid, but transparent.

The thickness and the transparency of the shells of the *Bullidæ*† vary from different causes. The truly marine and littoral species usually have it solid and thick, those living in brackish water like *Haminea*, thin and fragile, being more horny and covered with an epidermis; those living in deep water or in the high sea usually have a thin but compact and somewhat elastic shell, being, as a rule, without an epidermis.

Of the genus *Atys* H. and A. Adams quote two sub-genera, *Dinia* and *Sao*. In the former the inner lip terminates anteriorly with a dentiform plate; the latter mostly includes pyriform species, being gibbose anteriorly and usually umbilicated; the columella is reflexed, but not truncated. A. Adams says in Ann. mag. nat. hist., 1861, VIII, p. 139, that some of the species of *Sao* have been described under *Cylichna*, but that they neither belong to that genus nor to *Atys*, but have to be distinguished as a separate genus. In the next year (*ibid.*, IX, p. 158) the same author, in describing a number of new species of *Atys* from the Japan sea, sub-divides

* American Journal, XXXV, p. 93. On account of the great delay we usually have to endure in receiving American books, I only became acquainted with this paper last year, after the publication of the first part of our Gastropoda.

† As also of other Gastropoda.

this genus into *Atys, Roxania, Alicula* and *Sao,* thus admitting the last one again only as a sub-genus.

9. *Laona*, A. Adams, 1865 (Ann. mag. nat. hist., XV, p. 324), with the type *L. zonata*, which is semi-ovate, thin, the striæ of growth being lamellar, spire hidden; aperture with the inner lip arcuated, outer lip simple.

10? *Physema*, H. and A. Adams, 1857 (Gen., II, p. 21), has a globose, hyaline shell with the outer lip greatly dilated posteriorly, but a sharp linear inner lip with the columella reflected. The hyaline structure of the shell appears to be more that of a Pteropod than of an Opisthobranch.

Of the other genera, referred by H. and A. Adams to the *Bullidæ*, *Akera* belongs, I believe, to the *Oxynoeidæ*; *Scaphander, Smaragdinella* and *Cryptophthalmus* to the *Philineidæ*.

The shells of the *Bullidæ* being to a large extent thin and fragile are not common in the fossil state, and even of those which are more solid not many species have been described. The oldest and at the same time most numerous are the species of *Cylichna*, beginning in the Trias; *Bulla* is only known from the Jurassics, as likewise forms agreeing with *Haminea* and *Atys*.

The scarcity of the fossils is not unusually taken advantage of in describing imperfect specimens of shells, of which the proper generic characters often can hardly be traced out.

The following is a list of the cretaceous species :—

Cylichna.

1-3. *Cy. Etalloni*, P. and C.; *Cy. Tombeckiana*, P. and Renev., ? *Bulla Santonensis*, d'Orb. (*vide* Pictet Paléont. Suisse, 3me. Ser., p. 179).

4. *Cy. Mülleri*, Bosq., in Staring's Bodem van Nederland, IIde. deel (*Bulla cretacea*, Müller, not d'Orbigny).

5-7. *Cy. Palassoui, ovoides*, and *Baylei*, d'Archiac (Bull. Soc. Géol. France, 1854, XI, pp. 216-217, pl. 4, figs. 1, 2, and 9).

8. *Cy. reperta*, Coq. (*Bulla, id.*, Étage Aptien de l' Espagne, 1865, p. 83, pl. 3, figs. 11-13).

9. *Cy. Chilensis*, d'Orb., Voy. Astrolabe, Paléont., pl. 1, figs. 13-15.

10. *Cy. costata*, Gabb, Pal. Calif., I, p. 143, pl. 21, fig. 107, has very much the appearance of an *Atys*.

11-15. *Cy. minuscula*, Shum., *Cy. recta*, Gabb, *C. scitula*, M. and H., *Cy. secalina* and *striatella* of Shumard are quoted by Meek in his Check list of N. American cretaceous fossils, p. 16.

16-17. *Cy. Oregonensis* and *petrosa*, Conrad, are quoted by that author in his list of eocene fossils (p. 9); they are marked as occurring in the lower beds which Gabb and others maintain to be of cretaceous age.

18. *Cy. inermis* is the only species as yet found in our South Indian cretaceous deposits.

Volvula.

19. *Volvula dactylus*, Pict. and C. (Mat. Pal. Suisse, 3me. Ser., p. 174, pl. 60, fig. 5) is the only species belonging to this genus.

Actæonella.

20-24. *Actæonella lævis*, Sow. (including *Act. caucasica*, Zek., and *Act. obliquestriata*, Stol., as synonyms), *Act. crassa*, Duj. sp., *Act. glandulina*, Stol., *Act. faba*, Kner, *Act. dolium*, Römer (*vide* Sitz. Akad., Wien, 1865, LII, pp. 520-522).

Actæonella involuta of Coquand *(vide* ibid., p. 522) is most likely a cast of one of the *Cyprædidæ*, to which also the *Volvaria cretacea* of Binkhorst will belong.*

25. *Act. curta*, Eichwald, Leth. Rossica, XI. Livr., 1867, p. 829.

Bulla.

26. *Bulla avellana*, P. and C. (Mat. Pal. Suisse, 3me. Ser., p. 172, pl. 60, fig. 1) is most probably a true *Bulla.*

27. *Bulla Hornii*, Gabb (Pal. Calif., I, p. 143, pl. 29, fig. 235) is not a *Bulla*, but either a *Cylichna* or more probably an *Atys.*

28-33. *Bulla macrostoma*, Gabb, *B. minor*, M. and H., *B. Mortoni*, Forb., *B. Nebrascensis, speciosa* and *volvaria* of Meek and Hayden are quoted by Meek in his Check list of cretaceous fossils of N. America, p. 16. Of these *B. Mortoni* is evidently an *Atys; B. macrostoma* may either belong to this genus or possibly also to *Hydatina.*

Gabb in his Catalogue of cretaceous fossils (Proc. Am. Phil. Soc., VIII, p. 97) has also a species, *Bulla occidentalis*, M. and H., from Nebraska; I do not find this in the latter lists of American fossils. The *Bulla Mantelliana*, Sow. apud Fitton, which the same author quotes from the Neocomien, is a species of *Bullina (= Tornatina)* from the Wealden.

CVII. CYLICHNA, *Lovén*, 1846.

1. Cylichna inermis, *Stoliczka*, Pl. XXVII, Fig. 20.

Cyl. testa ovata, in medio subinflata, postice angusta ac sub-rotundata, antice latiore, spira infundibuliformi, immersa, superficie spiraliter minute striata; apertura lente curvata, postice angusta, antice paululum dilatata; labio crassiusculo, antice vix torto, fissura minuta.

Width of shell : its height (considered as 1·00) ... ... 0·47.

This species is distinguished by its rather regularly oval form, being posteriorly slightly more attenuated than anteriorly, but rounded on both ends. The spire is perfectly immersed, the posterior edge of the whorls rounded, but sloping towards the interior; the surface is very minutely spirally striated; the aperture slightly curved, posteriorly narrow, anteriorly somewhat broader, deeply indented at the termination of the columella, the inner lip being here somewhat thickened, but not very conspicuously twisted; there is a narrow but distinct fissure present.

Locality.—Comarapolliam, in a soft, light coloured sandstone; apparently very rare.

Formation.—Arrialoor group.

LX. *Family,—OXYNOEIDÆ.*

Lophocercidæ and *icaridæ*, auctorum.

The animals of the *Oxynoeidæ* are distinguished by having the foot laterally expanded into lappets or wings, which either partially envelope the shell when the

* Meek in his quotations of species of *Actæonella* also mentions *A. syrica*, Con., which, according to the figure given by Fraas, is a *Trochactæon.*

animal is at rest, or are used as organs of locomotion through the water; the body is often elongated posteriorly; the head is more or less produced, provided with two tentacles, which sometimes are rudimentary; eyes either present or wanting; the teeth are arranged in numerous series, each consisting of one central and numerous sub-equal laterals, the inner being somewhat dissimilar from the outer ones.

The shell is external, internal, or rudimentary, strongly involute or convolute, very thin and horny, posteriorly often with a slit or otherwise produced, anteriorly entire.

The genera to be placed in this family are;—

1. *Akera*, Müller, 1776 (H. and A. Adams, Gen. II, p. 18); shell involute, consisting of few whorls with very slightly elevated, truncate spire, thin, the last whorl disjoined from the others at the suture and deeply insinuated or provided with a narrow slit; the inner lip is anteriorly arcuated, the outer lip thin, posteriorly usually somewhat expanded and slightly inflexed.

H. and A. Adams, Gray, Chenu, and others place *Akera* in the family *Bullidæ*, but comparing the large development of the lateral lappets of the foot and the swimming* movements of the animal, as well as the dentition† and also the close relation in form and structure of the shell to that of *Cylindrobulla* and this one again to *Oxynoe*, it seems to me evident that the genus must be placed in this family. The posterior prolongation of the body of *Oxynoe* and *Lobiger* is indicated by the presence of the posterior slit in the shell of *Akera* and *Cylindrobulla*, and is in these two genera rudimentary.

2. *Cylindrobulla*, Fischer, 1856 (Journ. Conch. V, p. 275) differs from *Akera* in having a *convolute* shell, and the outer lip posteriorly approaching the inner one so much that the aperture is perfectly closed, remaining open only in front; the slit near the suture is exactly as in *Akera*. The animal does not appear to have been as yet observed alive.

3. *Oxynoe*, Rafinesque, 1819 (*Icarus*, Forb., 1844, *Lophocercus*, Krohn, 1847). Shell *convolute*, both lips produced posteriorly and forming a sort of channel, aperture much contracted posteriorly, widened in front. Animal with two lobes on the sides and posteriorly produced.

4. *Lobiger*, Krohn, 1847. Shell with a rudimentary, unilateral spire, last whorl large, expanded, aperture oval, open with entire margins. The animal is also posteriorly produced, but has two pairs of lateral lappets; it is more an oceanic shell, while *Oxynoe* usually crawls, as Mr. G. Nevill informs me, on coral reefs, like the *Bullæ*.

Mörch published a list of the species of the two last named genera in 1863, Journ. Conch. III, p. 43. An interesting account of some new species of *Cylindrobulla*, *Oxynoe*, and *Lobiger* from the eastern seas will shortly be published by Mr. G. Nevill.

* Meyer and Möbius observe that the movements of the animal of *Akera bullata* are a swimming or rather a flying through the water. This exactly agrees with what A. Adams says of *Gastropteron*.

† Eberhard observed the inner lateral teeth of *A. bullata* somewhat different from the outer ones.

The great relation of *Gastropteron* to *Lobiger* and other *Oxynoeidæ* makes it, as I shall subsequently mention, probable that this genus belongs to the present family, but as the former is again closely allied to *Aglaia (Doridium)* and to *Chelidonura*, it becomes very difficult to draw a line between the *Oxynoeidæ* and the *Philineidæ*. Comparing the animal of *Oxynoe* with that of many *Philineidæ*, the lateral edges of the foot are in both found equally to cover the sides of the shell, and the animal of *Oxynoe* crawls about like that of *Philine;* the only real difference rests, therefore, in the dentition, which is very peculiar in the *Philineidæ*. It would probably be better to retain the *Oxynoeidæ* only as a sub-family in the *Philineidæ*.

Fossil species of *Oxynoeidæ* are hardly known. Philippi noticed two *Oxynoe* from the upper tertiaries of Sicily. Deshayes' *Bulla goniophora* (Paris foss., 2nd. ed., pl. 38, figs. 26-29) is an *Akera*. If we, however, find perfect impressions of *Medusæ* preserved even in jurassic rocks, it is by no means improbable that the shells of the *Oxynoeidæ* may in time be found numerously represented among cretaceous fossils.

LXI. *Family,—PHILINEIDÆ.*

H. and A. Adams, Gen. II, p. 24, *ex parte;* Gray, Guide, 1857, p. 191.

The animals are of large size, having the tentacles united with the fleshy head-disk, which occasionally is emarginated posteriorly. The sides of the foot are dilated and cover the shell, often thus becoming internal, being more or less hidden under the mantle; the gizzard is provided with strong, calcareous plates. The dentition consists of two large hook-like, converging teeth, which sometimes have one much smaller on the outer side.

Shell internal or external, thin, consisting of few very rapidly increasing whorls, the spire being sometimes reduced to a mere point; aperture very large, margins entire, outer margin often somewhat produced.

The principal characteristic of the shell of the *Philineidæ* is the small number of whorls, the last of which expands into a very large aperture. I do not think the fact of the shells being internal or external can absolutely be of very great importance, for it seems to depend entirely upon the local development of the mantle whether this covers the shell partially or totally. In the former case, the exposed part of the shell will be more solid; in the latter, the entire shell will be chiefly membranaceous.

The following genera have to be placed, therefore, in this family :—

1. *Gastropteron*, Meckel, 1813. Body small with very large lateral expansions of the foot. Krohn says (Archiv f. Naturgeschichte, 1860-61, XXVI, p. 64, etc.) that the embryonal shell of *Gas. Meckelii* is spiral, consisting of one and a half rapidly increasing whorls; the shell of the full grown animal is almost only represented by a very thin, chitinous membrane, lying under the mantle covering the viscera and in front extending nearly to the head. This large membranaceous shell terminates in a spiral, calcareous point, which lies on the right side of the visceral region, nearer to the ventral side. Thus in form the

shell of *Gastropteron* comes very close to that of *Lobiger*, and as Krohn remarks also much resembles that of *Aglaia (Doridium)*. The same author, however, remarks that the radula of the young *Gastropteron* appears to be instructed with four longitudinal rows of hook-like teeth, which would evidently speak for a greater relation of *Gastropteron* to *Philine* than to the *Oxynoeidæ*, in which it had been placed. A. Adams (Ann. mag. nat. hist., 1861, VIII, p. 139), in describing a new species, *G. sinense*, says that three specimens which he observed "appeared to want the power of crawling altogether; the animals, after taking short flights, usually upside down, etc." The same author is also of opinion that the genus may better be placed in the *Oxynoeidæ*, to which it must be referred if the dentition agrees, for it must be observed that Krohn is by no means perfectly certain that his animal was truly the larva of *Gast. Meckelii*.

2. *Aglaia*, Renier, 1804 *(Doridium*, Meckel, H. and A. Adams, Gen. II, p. 27).

3. *? Posterobranchæa*, d'Orbigny, 1835 *(ibid.* p. 28*)* can only doubtfully remain in this family, as the position of the branchial plume on the left side and the emarginated or lobed hinder part of the foot appears to indicate further and more important distinctions in a classificatory sense.

4. *Philinopsis*, Pease, 1860 (Proc. Zool. Soc., Lond., p. 21). Shell rudimentary.

5. *Volvatella*, Pease, 1860 (*ibid.* p. 20) has a pyriform shell, aperture broad in front, posteriorly contracted and produced, forming a circular hole.

6. *Cryptophthalmus*, Ehrenberg, 1831 (H. and A. Adams' Gen. II, p. 23).

7. *Phanerophthalmus*, Adams, 1850 *(ibid.* page 25) *(Xanthonella*, Gray, 1850).

8. *Chelidonura*, Adams, 1850 (*ibid.* p. 26; *Hirundella* and *Hirundinella*, Gray, 1850).

9. *Bullæa*, Lamarck, 1801. This name ought to be reserved for the species which have a comparatively solid, in all probability external shell, in which the spire is reduced to a small inverted point, the outer lip being largely expanded and posteriorly produced like in *Chelidonura*, the inner rather thickened. Deshayes described lately (Paris fossils, 2nd edit., pp. 650-651, pl. 36) three fossil species.

Megistoma, Gabb, 1864 (Palæont. Calif. I, p. 144), which was proposed for the cretaceous *Meg. striata*, must be considered as identical with *Bullæa*, and as there is already a species of Deshayes called *B. striata*, the cretaceous species may be called *B. Gabbiana*, after the distinguished palæontologist of the Geological Survey of California.

10. *Philine*, Ascanias, 1772 (H. and A. Adams, Gen. II, p. 24) has a short, laterally convolute spire, the margins of the aperture largely expanded; the shells are very thin, membranaceous, being internal. The recent species are rather numerous and the animals particularly large.

11. *Smaragdinella*, Adams, 1850 (*ibid.* p. 22) is distinguished from *Philine* by a more distinctly marked involute spire, the shell being much narrower posteriorly, partially external; the inner lip has posteriorly a projecting thin, particularly twisted plate. In addition to the few species described under this generic name,

I may quote the *Haminea virescens*, which has a distinct plate on the inner lip, and Mr. G. Nevill, who observed the animal of this species on the coral reefs on the south coast of Ceylon, tells me that it only differs from that of *Smarag. viridis* in having the shell completely hidden by the meeting of the lateral expansions of the mantle which are folded over.

12. *Scaphander*, Montfort, 1810 (*ibid.* p. 19). Judging from the form of the shell and the character of the teeth of the animal this genus must be placed in the PHILINEIDÆ as first pointed out by Gray.

There are numerous fossil species of PHILINEIDÆ known from tertiary deposits, belonging to *Scaphander*, *Bullæa*, *Philine*, and apparently also to *Smaragdinella* and *Phanerophthalmus* or *Cryptophthalmus*, but excepting the Californian *Bullæa Gabbiana*, just mentioned, I am only acquainted with another cretaceous species noticed by Gümbel in 'Bayerische Alpen.', etc., 1861, p. 574, under the name of *Bulla subalpina*, of which that author says that in general form it resembles *Bulla lignaria*, and therefore this cretaceous species may be shown to belong to *Scaphander*, though it is impossible to form a reliable opinion from the short description which is given.

Order. PROSOPOCEPHALA.*

(*PROSOPOCEPHALA*, Bronn; *HETEROGLOSSA*, Gray; *CIRROBRANCHIATA*, Blainville; *SOLENOCONCHÆ*, Lacaze-Duthiers).

Shell tubular, symmetrical, open on both ends; animal with indistinct head and rudimentary respiratory organs; sexes separate, but the males have no copulative organ.

There are few other orders of Molluscs which offer greater contrasts in the different points of organisation than do the PROSOPOCEPHALA or the so called *Dentalia*. After it had been ascertained by the first careful anatomical examinations of Deshayes that they are true Molluscs, they have been generally placed in the neighbourhood of the PATELLIDÆ and the FISSURELLIDÆ. Later researches, especially those of Lacaze-Duthiers and of Sars, however, have shown that, compared with many other orders of Gastropoda, the PROSOPOCEPHALA appear to be of much lower organization. Up to the present only the animals of the DENTALIIDÆ have been examined, and their organisation seems to me to agree in the most important characters with the Gastropoda, as I shall presently show.

The body of the DENTALIIDÆ is tubular, like the shell, symmetrical, being enveloped in a mantle, which is open in front and behind. There is a strong muscle present near the anterior opening, and a ring-muscle near the posterior one, at which place only the animal is attached to the shell; while the body itself is for the greater length of the dorsal line attached to the mantle. The head

* This name is very characteristic; the name SOLENOCONCHÆ was proposed by Lacaze-Duthiers, and refers to the many similarities which these shells have to the Acephala. The name HETEROGLOSSA is not characteristic, and CIRROBRANCHIATA is not correctly applied, as has been shown by the anatomy of the animals.

is only indicated by a posterior indistinct furrow, and another one dividing it in two halves; next to it below is the foot, which is in front and often also on the sides somewhat expanded. The radula is short and composed of five longitudinal series of small transparent teeth, the mouth being besides usually provided with jaws and with a various number of tentacular appendages, occasionally of different length and thickness. The digestive organs lie immediately posterior to the head and extend backwards. There is no special central organ or heart present regulating the circulation of the blood, and it is impossible to distinguish between the arteries and the veins; there is, however, near the anus a strong muscle present, which at least supports the motions and vibrations of the blood. Special gills are wanting, and the respiration can take place through any portion of the body which comes in contact with the water; it is, however, probable that some places are more adapted to that purpose than others. Clark considers the symmetrical liver as gills, and says that the water enters to them through the posterior opening, thus making the resemblance to the Pelecypoda very close. Eyes are wanting, but the nervous system is otherwise rather complete and resembles some other Gastropoda. The sexes are distinct; the genital organs are placed symmetrically at the back of the posterior end; they are, however, in both very similar, consisting of three or more rows of blind sacks; the males have no external copulative organs; the fructification of the ova takes place through the water. The embryo has a very thin, usually somewhat inflated shell which generally is soon thrown off, being rarely retained and connected with the old one. The larva moves about with cilia, the body becomes gradually prolonged, the head surrounded with a number of appendages is indicated and a new tubular shell formed; thus the larva gradually more and more assumes the form of the old animal.

From these remarks the general relations of the *Dentaliidæ* to other Molluscs can easily be traced out. Lacaze-Duthiers proposed for them the name Solenoconchæ, considering the same as a third order of the Acephalomalacia. Sars has drawn attention to the similarities of the tentacles in the *Dentaliidæ* to those of the Cephalopoda. Bronn places his Prosopocephala intermediate as between and equivalent to the Pelecypoda and the Gastropoda. We have already remarked—and it is perfectly clear from the known anatomy of the animal—that the great inclination to the bilateral and symmetrical development of the organs places the Prosopocephala very close to the *Tubicola* of the Pelecypoda, and consequently Bronn's intermediate classification of the order appears to have very much in its favor. Still in comparing the structure of the shell of the Prosopocephala with that of the Gastropoda, the presence of a foot being adapted for locomotion and placed below the head, farther, the radula with its teeth as compared with those of *Tectura*, *Lepeta* and others, it appears to us that the Prosopocephala partake of the principal distinctive characters of the Gastropoda and ought, therefore, to be regarded as the lowest type of that class, equivalent to the Pteropoda or the Polyplacophora and other orders. We know from different other forms of Gastropoda, like *Rhodope*, and several other Gymnobranchiata that the gills are occasionally perfectly absent;

and again that the eyes become rudimentary or disappear altogether as soon as the necessity for their use ceases, like in many of the species of the Opistho- and Proso-branchia which bore in sand. Thus similar imperfections in the organisation as they occur in the Prosopocephala are actually common in other orders of the Gastropoda, and the same may be said with regard to the symmetrical development of some of the organs.

Sub-order,—Scaphopoda.

Family,—*DENTALIIDÆ*.

For the present only the *Dentaliidæ* can be referred to the sub-order Scaphopoda, the animals being characterized by a muscular foot, adapted for digging; at its termination, it being either provided with very short lappets or expanded into a kind of a disk. These differences in the form of the foot are accompanied by others relating to the organs of secretion and generation.

There are at the present only very few genera of the *Dentaliidæ* sufficiently established, but I think that even according to our present, as yet imperfect, knowledge of the animals and shells, they can conveniently be separated into two sub-families, *antalinæ* and *gadilinæ*.

a. *Sub-family*,—*ANTALINÆ*.

The animals possess a short, thick, anteriorly grooved foot, being either simply pointed at its termination or provided with short lappets; liver symmetrical, consisting of two equal parts.

Shell rather solid, elongated, tapering towards the posterior, pointed and perforated end, with or without a slit on the ventral side.*

1. *Dentalium*, Aldrovandus, 1642 (De testaceis, Lib. III, cap. V, p. 282—*id.*, Linné et auctores, H. and A. Adams, Gen. I, p. 456). Animal with a short foot, anteriorly thickened and tripartite. Shell tube-like, gradually tapering posteriorly, longitudinally ribbed, margin of the aperture sharpened, posterior end with an internal, slightly projecting tube, which is provided with a dorso-ventrally elongated opening, the outer layer having a very slight emargination in the same diametral direction, namely, dorso-ventrally.

Having examined a number of well preserved recent species, I believe the name *Dentalium* ought to be reserved for these longitudinally ribbed forms, as first pointed out by Aldrovandus. The shell has posteriorly no fissure, but the posterior margin of the outer layer is slightly indented on the dorsal as well as on the ventral side. The Indian *Dentalium sulcatum* of daCosta and Lamarck, or *Dent. elephantinum*, Linn., may be considered as the types of this genus. There are a number of recent and fossil species of this and the next genus known, which

* According to the anatomical results obtained by Sars, the concave side is the dorsal and the convex the ventral.

have internally on the posterior part of the dorsal side two longitudinal ridges. It remains to be shown in what connection these ridges are with the organization of the animal, and it is not improbable that further generic distinction is here indicated.

2. *Antale*, Aldrovandus, 1642 (De testaceis, Lib. III, cap. V, p. 282), ? *Entalium*, Defr., 1819. The animal appears to be similar to that of *Dentalium*, but the shell is tubular, generally much prolonged, smooth, the posterior end has the margin entire, the internal tube slightly projecting, and usually with a roundish opening.

The English smooth *Antale vulgare* of daCosta (*D. Tarentinum* of Lamarck) or *Dent. duplex*, Desh., and *Dent. ambiguum*, Chenu, may be considered as typical species of this genus. Aldrovandus was the first who proposed a distinction between the longitudinally ribbed and the smooth *Dentalia*, calling the latter *Antale*, but I cannot trace the name *Antalis*, as adopted by H. and A. Adams in their Genera for species belonging to the next genus.

The name *Entalium** was proposed by Defrance (Dict. sc. nat., vol. XIV, p. 517) for a species from the Maestricht Chalk, *Pyrgopolon Mosæ*, Montf., which he called *Ent. rugosum*. This species appears to agree in its general characteristics with *Antale*, being smooth or slightly rugose, with the margins of the posterior aperture roundish, entire, and usually with an internal tube which more or less projects. On account of this internal, supplementary tube, which most probably owes its origin to the embryonal shell, it being retained in subsequent growth as likewise in many other genera of the *Dentaliidæ*, Defrance proposed for the Maestricht species the name *Entalium*. How in most of the Conchological works the idea of applying the name *Entalium* to such species as have the posterior end fissured has been introduced I am unable to trace out just at present, and it is of little consequence, as the name itself cannot be used in the sense in which Defrance proposed it.

Should the Maestricht species prove to be generically distinct from *Antale*, it must either be called, according to Montfort, *Pyrgopolon* (or, according to König, *Pharetrium*, the type of the last being *Ph. fragile*, König)—(see Chenu's Conch. Illustrations). *Dentalium clava*, Lam., would be another species of *Pyrgopolon*, and I suspect that the genus has to be placed in the *Gadilinæ*.

3. *Entalis*, Gray,† 1840 (*Antalis*, H. and A. Adams, Gen. I, p. 457, *ex parte* ? non *id.* Aldrovandus). Shell tube-like, slightly curved, longitudinally ribbed or sometimes striated, gradually tapering towards the posterior end, which has the margin on the ventral or convex side provided with a short and broad fissure. The type of this genus is the *Dentalium entale* of Linnè, as emended by Forbes and Hanley in their Brit. Moll. II, p. 450. Chenu in his Conchological Illustrations

* Not *idem*, *Linnè*; Scheuchzer called the *Dent. elephantinum* also an *Entalium*.

† Sowerby (1842) is usually quoted as the author of this genus. It is really difficult to determine whether Gray or Sowerby used the name first. Sowerby's name bears the date of 1842, but Gray's Synop., Brit. Museum, was published in 1840, though Gray himself adds to his name the date 1844—see Proceed. Zool. Soc., London, 1847, p. 158.

figures several species, like *D. Delesserti*, Chenu, and *D. grande*, Desh., which also are type species of this genus. Others are described by Deshayes in his last work of the Paris fossils (pl. I and II of vol. II). The posterior end is usually longitudinally striated even when these striæ or ribbings become obsolete towards the aperture, but the principal characteristic of this genus rests in the short and wide slit of the ventral or convex side of the posterior end, while the dorsal margin is entire or very slightly emarginated. In *Dentalium* (as restricted) the margins are either entire or dorso-ventrally slightly indented, so that the distinction is only a very gradual one; but as the animals also appear, by the more cylindrical and pointed form of the foot, etc., to exhibit some differences, a generic separation seems very desirable. The existence or want of the posterior supplementary tube does not appear to be of any great generic importance, inasmuch as it is occasionally present or wanting in very allied forms, or even in different specimens of the same species. Probably it often depends upon the circumstances under which the animal lives whether the embryonal shell is retained or not, and if it has been accidentally lost, whether its form be newly restored or not.

I have no specimens of the true *Dent. entalis*, Linn., to compare, but Forbes and Hanley (Brit. Moll. II, p. 450) say that 'the posterior termination has either a labial projection, which is rather broadly fissured dorsally (being ventrally), or, if it have not experienced that reparative process, is then very tapering, and has a short shelving notchlike dorsal (ventral) fissure.'

H. and A. Adams' figure of *Antalis entalis* exhibits the character of the ventral fissure very clearly. The opening in the supplementary tube is transverse, as usual in the *Dentaliidæ*; it is ventrally somewhat more prolonged, forming a kind of a notch and being in connection with the fissure of the shell. In *Dentalium* the transverse opening of the supplementary tube, when present, is separate, not connected with the emargination of the shell.

4. *Fustiaria*, Stoliczka, 1868. Shell tubular, thin, usually slightly curved, smooth, posterior end with a long, linear slit on or near the ventral side.

Dentalium eburneum, Lamck., *Dent. circinatum*, Sow., and others figured by Sowerby in his "Genera of shells," by Deshayes in his last edition of the Paris fossils, etc., are typical species belonging to this generic group of the *Dentaliidæ*. Comparing the shells of *Fustiaria* with those of *Entalis* it will be seen that the former are usually smooth, thin, having the front part rather cylindrical and then quickly tapering towards the posterior end, the ventral side of which possesses a very narrow, linear slit; in *Entalis*, on the contrary, the shell is usually more consistent and thicker, longitudinally striated, uniformly tapering from the anterior towards the posterior end, the slit being broad and short, specially widened at its termination. The relations and differences between these two genera are about the same which we have pointed out as existing between *Pleurotomaria* and *Leptomaria* (see p. 382).

Some of the species, like the *Dent. nebulosum*, Desh., figured in Chenu's Conchological Illustrations, or our *Fust. parvula* from the Indian cretaceous deposits,

have the fissure non-symmetrically ventral, being placed somewhat laterally to the left; but as there are as yet no other noticeable distinctions between the typical shells of this genus to be given, it does not appear necessary to make a further separation into genera or sub-genera. I am not aware whether any recent species of *Fustiaria* have been described, but I have little doubt that when the animal has been observed, it will be found to exhibit equally marked distinctions from that of *Entalis* as does the shell.

b. *Sub-family,—GADILINÆ.*

This sub-family ought principally to include the species called by Sars *Siphonodentalium*, the animals of which have a very long cylindrical foot, ending in a ciliated, flat or conical disk, the lips of the aperture have no appendages, and the liver is unsymmetrical.

The shells in general resemble those of the *ANTALINÆ*, but as they appear usually to inhabit deep waters they always consist of a thin substance; the posterior end is generally less pointed and more widely opened than in the previous sub-family.

5. *Siphonodentalium*, Sars, 1859 (*Om Siphonodentalium vitreum*, etc., Universitets-Program, Christiania, 1861). Shell tubular, tapering posteriorly, being occasionally cylindrical or even somewhat contracted anteriorly, aperture circular with entire margins, posterior end with the margin lobed.

The genus *Siphonodentalium* must be restricted to species of the type *Siph. vitreum*, Sars, that is, to those forms which have the margin at the posterior termination of the shell lobed. In *Siph. vitreum* there are six short fissures all round the margin, but of these the dorsal and ventral ones appear to be slightly longer, or deeper, than the other four. Beside this recent species I am acquainted with three fossil ones, lately described by Deshayes as *Gadus parisiensis*, *G. bilabiatus* and *G. brevis* (Paris fossils, 2nd edit., pp. 218-219, etc.); all three species have the posterior margin symmetrically and on both sides distinctly fissured, in the first species the rest of the margin being numerously but less deeply indented, while in the two others it is not indented at all. It is not improbable that further investigations may render it desirable to divide this genus into different sections or sub-genera, but until more species* of these shells are known and more animals have been examined, the limit of these sub-generic groups could not be ascertained, nor do they appear necessary at present. Chenu in his "Illustrations Conchil." (pl. 6, fig. 31) gives a figure of a *Dentalium turritum*, Lea, which closely resembles *Siphonodentalium vitreum*, only having the shell a little thicker. Lea (Contr., p. 35) says that there are at the posterior end only four appendages, not six, as in the recent species; *Siph. turritum* was found in the eocene beds of Alabama. I also may mention that the names of the two species *Siph. parisiense* and *S. bilabiatum* of Deshayes have to be replaced by *Siph. denticulatum* and *S. bifissuratum* respectively, the same

* One species was described by Searles Wood in the Annals Mag. nat. hist. of 1842.

species having been under these names figured by the same author already in his "Traitè elem. de Conch.," pl. 61, figs. 13, 15, 16, and figs. 11, 12, 14. Thus all the species of *Siphonodentalium* known at present are six, one recent and five tertiary.

6. *Gadila*, Gray, 1847 (Proc. Zool. Soc., London, 1847, p. 159—*Gadus*, Montagu, teste Rang, non *id.* Linn). Shell tube-like, generally of moderate length, thin, almost hyaline, smooth, thickest near the middle, somewhat contracted towards both ends, more so towards the posterior one; margin of both ends entire.

The animal is similar to that of *Siphonodentalium*, under which generic name Sars described a recent species, *Gadila (Siph.) subfusiformis* (Forhandlinger i Vidensk., 1864, p. 301, figs. 36-44).

The oldest known species evidently belonging to this genus is the (tertiary or recent?) *Dentalium gadus*, Montagu (or Lamarck *teste* Deshayes),* for which, according to the authority of Rang, Montagu ought to have used the generic name *Gadus*, though this point is by no means very clear. In his Manuel of 1829, p. 116, Rang simply states that he unites *Vaginella* of Daudin and *Gadus* of Montagu with his sub-genus *Cresis* (non *Créséis)*.

The name *Gadus* having been, however, previously used by Linnè, it cannot be here applied again, as proposed by Deshayes in his last edition of Paris fossils and followed by Conrad and others (Am. Journ. Conch. II, p. 75). From the description given by Rang of *Cresis*, it is also evident that his species belongs to the Pteropoda, and therefore Gray's name *Gadila* must be retained for this group of shells. Lamarck's *Dent. coarctatum*, figured by Chenu in his "Illust. Conchil.," is stated to be identical with *Gadila Gadus*, Mont. Several other fossil species, however, also belong to this genus, which appears to be represented already in the lower jurassic strata; it is even possible that some of the palæozoic *Hyolithes* belong to *Gadila* or allied genera. The cretaceous species will be mentioned subsequently.

6 a. *Helonyx*, Stimpson, 1865, (Amer. Journ. Conch. I, p. 63). This name was proposed for *Dent. clavatum*, Gould, the animal of which Stimpson observed in the Hongkong harbour, where it lives on the muddy bottom at a depth of about 20 fathoms. The shell does not appear to differ from *Gadila*, but the animal is figured with a rather pointed foot, while the description says that it is "obtuse at the extremity." It does not appear, however, to terminate with such a flat disk as observed in the species described by Sars, and until further researches have been instituted, it may seem desirable to retain Stimpson's name, at least for the one recent species.

7. *Pulsellum*, Stoliczka, 1868. *(Siphonodentalium*, Sars, *ex parte)*. Shell tubular, thin, smooth, or longitudinally ribbed, gradually tapering towards the posterior end which is truncate, with the margin entire. This genus is proposed to include the three recent species described by Sars as *Siphonodentalium lofotense*, *affine* and *pentagonum* (Forhandliger Vidensk., etc., 1864, p. 297, etc.). The animals closely resemble those of *Siphonodentalium vitreum*, only showing slight differences

* Traitè de Conch., p. 36, pl. 61, figs. 8-10.

in the ciliated fringe of the disk of the foot, but the shells are readily distinguished from it by the entire margin of the posterior end: this distinction also applies as regards *Dentalium*, but the separation from *Antale* is more difficult, being apparently restricted to the more truncated shape of the posterior end in the present genus, and to a more hyaline structure of the shell. There are a large number of fossil, smooth species known, being distinguished by a remarkably thin shell, but until the exact form of the posterior end has in each special case been closely investigated, so as to ascertain whether the shell is at this point perfect or not, it would be of no use to propose any transfers of the species.

These seven generic divisions as here distinguished represent, I believe, only the principal types, and it is very probable, as I had repeatedly occasion to notice, that the number of genera must soon be considerably increased. In all the recent species, so far as their animals have been observed, the foot is more or less cylindrical, adapted for digging in the sand, and consequently they all belong to the sub-order SCAPHOPODA. It will, however, be very desirable to examine also carefully some of the PTEROPODA with similarly formed shells. Supposing that the animals of some of these shells are identical in organization with *DENTALIIDÆ*, but that their foot is provided at its termination with wing-like lappets, which are better adapted for swimming than for creeping or digging, there must be a new sub-order for these shells formed in the PROSOPOCEPHALA. I greatly suspect that this will probably have to be done with some of the species at present referred to *Cresis*, *Cleodora* and *Vaginella*, being remarkably thin shells, but apparently differing from typical species of these genera by having the posterior end pierced by a minute hole.

Of recent species of *DENTALIIDÆ* there are about sixty known; they are found in all seas, though not very numerously represented, chiefly living on sandy or muddy ground between five and one hundred fathoms. The number of fossil species will amount to about one hundred. The first species are usually quoted from the devonian, but there are several silurian forms known which can hardly be excluded from this family, and it besides remains to be ascertained whether all the species described under *Hyolithes* are truly Pteropodous shells. The tertiary species are more numerous than those from any of the other formations.

In giving a list of the species which have been described from cretaceous deposits I shall first mention those noticed by Pictet and Campiche in the "Paléont. Suisse," 3me. Ser., pp. 725-728, and then note any further additions made since the publication of that memoir.

1. *Dentalium valangiense*, Pict. et Camp., is probably a species of *Antale*.
2. *Dent. cylindricum*, Sow., is apparently also an *Antale*, but it may belong to *Gadila*.
3. *Dent. decussatum*, Sow., is a true *Dentalium*.
4. *Dent. Rhodani*, P. and R., is also a *Dentalium*.
5. *Dent. medium*, Sow. (Trans. Geol. Soc., Lond., 2nd ser. IV, p. 343, pl. XV, fig. 4, according to Sowerby's own statement same as figured in Min. Conch., pl. 79) has the form of a true *Dentalium*, but one of the figures in the Transactions appears to exhibit a short slit near the posterior end, in which case the shell must be referred to *Entalis*.

? 6. *Dent. Geinitzianum*, Ryckholt, has been proposed for a species considered to be identical with *Dent. medium* figured by Sowerby apud Fitton, but Sowerby says that the figure of *D. medium* in the Min. Conch. is a bad one of the same species, as the one figured in the Transactions, and this appears very probable. Ryckholt, however, says that they are both distinct, and that the description in the Min. Conch. is perfect. Unless the originals have been examined Ryckholt's decision must be accepted only conditionally. There is, however, no reason to be given why two similar but still distinct species ought not to occur at Tournay.

7. *Dent. septangulare*, Fleming, is doubtful.

8. *Dent. cælatulum*, Baily, is a *Dentalium*.

9. *Dent. Rotomagense*.

10. *Dent. lineatum*, Guéranger (Album pal., 1867, pl. 14, fig. 36) is apparently a true *Dentalium* and closely allied to *D. nutans*, Kner.

Dent. deforme, Lamck. in Guéranger's Album pal., pl. 16, fig. 37, must most probably be referred to the *Serpulidæ*.

? 11. *Dent. cidaris*, Geinitz, appears to be closely allied to *Dent. Rhodani*, P. and Roux.

? 12. *Dent. (alternans*, Ryckholt), 1852 (non *id.* Müller, 1850) only differs from the last species by having the shell very slightly curved, though Geinitz said, when he first (Char. II, p. 74) described the *Dent. cidaris*, under the name of *Dent. striatum*, that the shell is slightly curved or straight.

13. *Dent. Michauxianum*, Ryckholt, may be an *Antale*, but judging from its cylindrical form it can also belong to *Fustiaria;* the posterior end of the shell not having as yet been observed perfect.

14. *Dent. bicostale*, Ryckh., probably an *Antale*.

15. *Dent. glabrum*, Geinitz, is an *Antale* or a *Fustiaria*.

15 a. *Dent. glabrum*, Geinitz apud Müller, Monog. Petref. Aachner Kreide, 1851, pt. II, p. 5, is a *Fustiaria*, having a slit of about $\frac{1}{4}$ inch long at the ventral side.

16-18. *Dent. polygonum*, Rss., *Dent. laticostatum*, Rss., and *Dent. nutans*, all belong to *Dentalium*.

19. *Dent. Sacheri*, Alth. The shell of this species is smooth like an *Antale;* no mention is made in the description of the existence of a posterior slit, but the figure seems to show a long and very narrow fissure as characteristic for *Fustiaria*.

20. *Dent. multicanaliculatum*, Gümbel (Geogn. Besch. Bayer. Alp., p. 572) appears to be closely allied to *Dent. nutans*, Kner, but of larger dimensions.

21. *Dent. rugosum*, Müller, may belong to *Antale*.

22. *Dent. alternans*, Müller, apparently a true *Dentalium*, and not unlike the *D. nutans* of Kner.

23. *Dent. nudum*, Zek., belongs probably to *Fustiaria*.

24-25. *Dent. Nysti*, Binkh., and *Dent. planicostatum*, Heb., appear to belong to *Dentalium*, as restricted.

26. *Dent. Mosæ*, Montf., has either to be placed in the genus *Antale* or form the type of the genus *Pyrgopolon*.

27. *Dent. (cidaris*, Geinitz) in Müller's Monog. Petræf. Aach. Kreidef. Suppl., 1859, p. 20, pl. 8, fig. 6, appears to differ from the true *Dent. cidaris* by its much compressed form and want of intermediate thinner ribs.

28. *Dent. notabile*, Eichw. (Leth. Ross., XI livr., 1867, p. 800, pl. 28, fig. 1) is probably an *Antale*.

The same author also mentions as occurring in the cretaceous rocks of Russia, *Dent. ellipticum*, Sow. (which is known to be a cast of *D. decussatum*, Sow.), *Dent. glabrum*, Geinitz, *Dent. striatum*, Sow. (= *Dent. cidaris*, Geinitz?), and *Dent. medium*.

29-33. *Dent. fragile*, and *Dent. gracile* of Meek and Hayden, *D. subarcuatum*, Conr., *D. nanaimoense*, Meek, and *D. Ripleanum*, Gabb, mostly appear to belong to *Dentalium*.

34. *Dent. pauperculum*, Meek and Hayden, is an *Antale*.

35. *Dent. Chilense*, D'Orb., very much resembles in form our *Antale*.

36-37. *Dent. Cooperii* and *stramineum*, Gabb, Pal. Calif., I, p. 139, are true *Dentalia*.

38. *Dent. (Ditrupa) pusillum*, Gabb, *ibid.*, is a *Gadila*.

39. *Dent. syriacum*, Conrad, from Palestine, is either an *Antale* or a *Pyrgopolon*.

40. *Dent. cretaceum*, Conrad, from Syria, I do not know.

?41-42. *Dent. Wilsoni* and *octocostatum* of Fraas from Palestine (Würtemb. Jaresh., XXIII, p. 239) are probably *Annelides*.

In our South Indian cretaceous rocks occur four species, the descriptions of which are given below :—

43. *Dentalium crassulum*, Stol.

44. *Antale Arcotinum*, Forbes, sp.

45. „ *glabratum*, Stol.

46. *Fustiaria parvula*, Stol.

Dent. hamatum, Forbes, (Trans. Geol. Soc., London, VII, p. 138, Pl. XV, Fig. 8), is, according to the originals, examined by me in the London Geological Society's collection, based upon an imperfect cast of a longitudinally ribbed *Serpula*. Forbes' original figure is taken from a fragment imbedded in a calcareous sandstone, which is wholly perforated with these Annelid tubes, the shells being thick; externally they appear to have four longitudinal somewhat distant ribs on one-half of the circuit and five somewhat closer set on the other. The external layer of the shell is more compact than the inner, which breaks in thin lamellæ. On the section the longitudinal ribs are perfectly clearly traceable, but the shell is so thoroughly attached to the rock that it always only leaves the cast visible as soon as the specimen is broken longitudinally.

CVIII. DENTALIUM, *Aldrovandus*, 1642.

1. Dentalium crassulum, *Stoliczka*, Pl. XXVII, Fig. 21.

Dent. testa crassa, elongata, parum curvata, longitudinaliter costis undenis crassioribus atque nonnullis minoribus interpositis ornata, transversaliter minutissime striolata; sectione rotundata.

This species is distinguished from allied forms, like *Dent. decussatum*, Sow., and *D. nutans*, Kner, by the number of distant longitudinal stronger ribs, being eleven in the entire circumference, and having sometimes two to three thinner ribs between them. Two of the stronger ribs on the left side, but near the median dorsal line, are generally somewhat more approximate than the others. The posterior termination is rather sharply pointed, though its surface is a little corroded on most of our specimens; there is, however, no slit present.

Locality.—South of Serdamungalum, in yellowish arenaceous limestone; apparently very rare.

Formation.—Trichinopoly group.

CIX. ANTALE, *Aldrovandus*, 1642.

1. Antale Arcotinum, *Forbes*, sp., Pl. XXVII, Fig. 23.

1846. *Dentalium Arcotinum*, Forbes, Trans. Geol. Soc., Lond., VII, p. 138, Pl. XII, Fig. 16, *idem.*, auctorum.

Ant. testa cylindraceo-subulata, tereti, subarcuata, levigata, transversaliter striis minutissimis notata.

The cylindrical shape of the anterior portion of the shell and the gradual tapering towards the posterior end are very characteristic for this species. The surface is quite smooth to the eye, but under the glass fine, concentric, transverse striæ can distinctly be traced. The shell is rather thick posteriorly, but much thinner towards the anterior end.

Locality.—Pondicherry, in bluish calcareous sandstone; rather rare.

Formation.—Valudayur group.

2. Antale glabratum, *Stoliczka*, Pl. XXVII, Figs. 24-25.

Ant. testa elongata, moderate arcuata, antice paulo dilatata, levigata, dorsaliter sulcis duobus longitudinalibus, sub-obsoletis notata.

This species in form closely resembles *Antale (Fustiaria ?) glabrum*, Geinitz, being smooth, moderately curved, and having at the dorsal (or concave) side two slight, longitudinal furrows; the posterior end is very gradually pointed, but the anterior end rather widened, and at the perfect aperture the dorsal margin is considerably more produced than the ventral one; this being sometimes indicated by a furrow on the shell itself, corresponding to a previous stage of growth. The section of the shell is circular.

Locality.—Odium, in brownish calcareous sandstone; not very rare.

Formation.—Ootatoor group.

CX. FUSTIARIA, *Stoliczka*, 1868.

1. Fustiaria parvula, *Stoliczka*, Pl. XXVII, Fig. 22.

Fust. testa pusilla, subulata, antice cylindracea, postice acuminata, tenui, subvitrea, polita; fissura angustissima, sinistra prope lineam ventralem sed excentrice sita.

A small, thin, posteriorly pointed shell with the fissure situated near the ventral or convex side; the greatest thickness is near the middle, at least it is not greater at the aperture, the margin of which is very thin and circular; the surface is polished. The small form and shape of this shell very much resemble a *Gadila* or *Siphonodentalium*, but there is a distinct fissure present, the rest of the posterior margin being entire.

Locality.—Pondicherry, in bluish, calcareous sandstone; only the figured specimen has as yet been obtained.

Formation.—Valudayur group.

APPENDIX, A.

The progress of research makes it necessary that frequent additions and corrections should be made in Natural history publications, and the opportunity of effecting these should never be lost. Although little more than a year has elapsed since the publication of the first four Fasciculi of the cretaceous Gastropoda of South India, and only a few months since the succeeding portions have been set in type, still the additions, or rather corrections, are comparatively rather numerous. These are, however, to a large extent such as add much to the value of the work, being essential to its completeness, so far as this can be attained at the present date, from materials, relating to the South Indian cretaceous Gastropoda, anywhere available for examination.

The reasons which necessitate these corrections are mainly three-fold; firstly, I have no hesitation in saying, due to an occasional oversight on my own part, which, however, is considerably palliated by the other two causes, namely, the inaccessibility of references and of original materials for comparison. It is only since the first four fasciculi have been issued that we have obtained some of the most important old works bearing on the history of Conchology, as, for instance, those of Aldrovandus, Argenville, Klein, Adanson, Montfort, and others. Of newer works we have received Sowerby's Genera, Troschel's 'Gebiss der Schnecken,' the American Journal of Conchology, of which three volumes are nearly completed, and a large number of periodicals containing valuable conchological papers. Of palæontological works not many have been lately published relating to this branch; I may mention Guéranger's "Album paléontologique," the XI livraison of Eichwald's "Lethæa Rossica;" Fraas' account of Palæstine in the "Würtembergische Jahreshefte," the "Paléontologie" of Tchihatcheff's "Asie Mineure," some of the Catalogues of the "Smithsonian Miscellaneous Collections," and a few others.

In describing the first portion of the South Indian cretaceous Gastropoda I had repeatedly cause to mention the difficulty accompanying the identification of some of the species described and figured by Prof. Forbes. A large part of Forbes' materials were procured by Messrs. Kaye and Cunliffe in the neighbourhood of Pondicherry, from which locality we had only very few specimens, and many of them not even in an equally good state of preservation as those from the older collections. It is natural that, when descriptions are taken from imperfect specimens, they must remain imperfect, and can be completed or corrected only whenever better materials have been procured. But when the descriptions contradict the figures, or one does not sufficiently express what may be seen in the other, and besides when the figures are not very good, it is almost impossible to be certain of any specific identification. The *est* and *non est* have almost equal chances of probability, and with the greatest caution mistakes, or rather inaccurate interpretation of figures, are sometimes unavoidable. I felt, as already stated, this uncertainty as to several identifications in the first part of the Gastropoda very much, and at the same time I saw that, as soon as my examination had extended to the more minute forms of the PROSOBRANCHIA CTENOBRANCHIATA HOLOSTOMATA, the doubtful cases would considerably increase. Upon the representation of the Superintendent of the Geological Survey and through the liberality of the Government this has happily been avoided.

I was permitted to proceed to Europe not only to examine Prof. Forbes' original collection, which had been presented by Messrs. Kaye and Cunliffe to the London Geological Society (which Society ably supported my endeavours), but I was at the same time authorised to visit the principal Museums of Europe, and collect such data and information as I might think necessary for the improvement and completeness of this publication. As far as time, circumstances, and other important duties permitted, this has been satisfactorily done. It is seldom that an author in writing a monograph upon a palæontological subject, of which others had previously treated, can enjoy such an opportunity of examining all the original specimens of his predecessors as I did. The liberality of view which considered these examinations a part of 'duty' shows the appreciation of Science on the part of the Government of India, and their earnest desire to support and advance such enquiries.

The corrections and additions which I am now about to record refer principally to the first four fasciculi published last year.

Order. PULMONATA.

Family,—HELICIDÆ.

For *Anchistoma* on pp. 7, 8, 9, 10, 11, etc., read *Angystoma*, as first used by Klein in his Tent. Meth. Ostr., 1753, p. 10.

Order. PROSOBRANCHIA.

For CTENOBRANCHIA, ASPIDOBRANCHIA, CYCLOBRANCHIA, etc., on p. 13 and the following pages, read CTENOBRANCHIATA, ASPIDOBRANCHIATA, CYCLOBRANCHIATA, etc.

I. *Family,—ALATA.*

On p. 23, for *Aporrhais*, da Costa, 1778, read "*Aporrhais*, Petiver, 1711." Aldrovandus is generally quoted as the authority for the name *Aporrhais*, but this is, in the sense in which the genus is at present adopted, not correct, unless we would agree to imply by the name of the author simply that Aldrovandus used the name *Aporrhais* for a shell of the *ALATA*, but in such a case, I should think, Aristoteles would be the oldest authority.

Aldrovandus (apparently following Aristoteles) used the name *Aporrhais* for *Pteroceras lambis* ("see, de reliquis animalibus exanguibus, etc., Bonn, 1642, pp. 341-344)." In the same work on pp. 357 and 358 Aldrovandus gives several figures of the Mediterranean *Ap. pes-pelicani*, Linn., calling the same a variety of *Turbo*, but at the same time stating that Plinius named it *Pentedactylos*. Consequently Aldrovandus cannot be accepted as the authority for the genus *Aporrhais*, as at present used in the literature of Conchology. There can be no question that all the names used by Aldrovandus are applied in a very vague sense, and can hardly have any influence upon the present system of nomenclature, for his names were, strictly speaking, not generic and specific. At the same time I believe there can be no objection to use those loose names of old authors in an emended way.

Klein used the name *Aporrhais* in a proper generic sense, but it is hardly possible to decipher its meaning. The specimen figured by him may be an imperfect *Strombus gallinula*, though he says the name refers to a "Voluta conica, ore longo ad turbinem sinuato" (see Ten. Meth. Ostr., 1753, p. 79). Da Costa in his "Elements of Conchology," 1776, p. 282, pl. I, fig. 6, uses the name *Aporrhais* again for *Pteroceras lambis*, also in exactly the same sense as does Aldrovandus. Petiver remains the only old authority for the name *Aporrhais*. I am unable to refer to Petiver's original publication of the name to determine whether he applies it to *Ap. pes-pelicani*, but Dillwyn (Phil. Trans., 1823, p. 396) states distinctly that Petiver's name ought

to be restricted for the large number of fossil species, the recent representant of which is *Ap. pes-pelicani*, Linn. He at the same time very correctly points to the distinctions not only of the shells of *Aporrhais* from *Rostellaria*, but also of the animals; and even should Petiver himself not have pointed out the type of his genus, the name would have full authority since 1823, consequently long prior to Philippi's name *Chenopus*.

Since my notes, l. c., pp. 26 and 27, as to the relations of *Aporrhais*, *Rostellaria*, and others have been written, several new genera of the *Alata* have been proposed by American authors. The more important are the following:

1. *Isopleurus* (or *Isopleura)*, Meek (Check list cret. and jur. foss., Smith. Misc. Coll., 1864, pp. 20 and 36, with the type *Rimella curvilirata*, Conrad, Journ. Acad. Nat. Sc. II, 1858, p. 331).

2. *Pterocerella*, Meek, *ibid.*, p. 36, with the type *Harpago tippana*, Conr., Jour. Acad. N. Sc., III, p. 331.

3. *Leiorhinus*, Gabb, Am. Journ. Conch., I, 1865, p. 30, type *L. californicus*, Pac. Railroad, V, p. 322.

4. *Platyoptera*, Conrad, *ibid.*, p. 31, type *P. extenta*, Proc. Ac. Nat. Soc., VII, p. 260.

5. *Alipes*, Conrad, *ibid.*, p. 31, a sub-genus of *Aporrhais*.

Aporrhais securifera, *Forbes*, p. 28.

Rostellaria cancellata, Forbes, Trans. Geol. Soc., Lond., VII, p. 128, or *Rost. cancellifera*, Forbes, ibidem, pl. 13, fig. 18, being based upon a few of the upper whorls of *A. securifera*, Forb., must be added as a synonym of the last species.

Alaria Parkinsoni, *Mantell*, p. 30.

Agassiz (Sowerby's Min. Conch., Germ. edit., 1837, p. 381) proposed for this species the name *Rost. Sowerbyi*, though this ought rather to apply to the original species of Parkinson, which is from the London clay.

PTERODONTA, *d'Orbigny*, p. 35.

Strike out the names *Tylostoma*, Sharpe, and *Varigera*, d'Orbigny, from the synonyms, and refer for farther explanation to page 292, *tylostominæ*.

For *Pterodonta bulimoides*, Stol., p. 42, read *Tylostoma bulimoides*.
For „ *nobilis*, p. 43, read *Tylostoma nobile*.
For „ *Ootatoorensis*, Stol., p. 43, read *Tylostoma Ootatoorense*.

II. *Family,—CYPRÆIDÆ*, p. 44.

Troschel (Gebiss der Schnecken, vol. I, 1853-1863) replaced this family by four, namely, *Cypræacea* (l. cit., p. 201), *Triviacea* (l. cit., p. 214), *Amphiperasidæ*, p. 216, and *Pediculariacea*, p. 189. It cannot be questioned that there are

some differences in the form of the jaws and in the teeth of the radula between these so called families, but we doubt very much whether the distinctions are actually so very important as to necessitate another division of the *Cypræidæ*, than that we have adopted, namely, into three sub-families, *ovulinæ*, *cypræinæ*, and *pediculariinæ*. The dentition of *Pedicularia* is said to be thoroughly distinct from that of any known family, but on comparing it with that of *Trivia* and *Erato* one almost fails to detect such an essential difference as pointed out in the description. The teeth of the *ovulinæ* (or *Amphiperasidæ*) appear far more distinct than those of any of the other families. We really cannot as yet see the benefit derivable from the distinction of such a number of families, inasmuch as closely allied shells and animals are removed far from each other, but it is just as possible that farther investigations and anatomical researches may prove their propriety.

In his *Cypræacea* Troschel distinguishes three genera:

1. *Cypræa*, Linn. Shell with labial groove enlarged into a spoon-shaped excavation.

2. *Aricia*, Gray, labial groove not enlarged; occasionally indistinct.

3. *Pustularia*, Swains.; shell tuberculated.

Farther, the same author distinguished a number of sub-genera, the genus *Cypræa* being divided into *Talparia*, *Tigris*, *Lycina* and *Mauritia*; that of *Aricia* into *Erronea*, *Erosaria* and *Monetaria*. We again would hesitate to give these sub-generic distinctions preference to those stated in Gray's and H. and A. Adams' works. Some of them may prove of great convenience, but how, for instance, *Cyp. (Aricia) Mauritiana* and *Cyp. (Aricia) caput-serpentis* ought to be separated into two distinct genera, the first belonging to the sub-genus *Mauritia* of *Cypræa* and the other to *Erosaria* of *Aricia*, I am unable to detect.

The *Triviacea* of Troschel include the genera *Trivia* (of which *T. europæa* is the type) and *Erato*. No important alterations are made as to the genera of the other families.

b. *Sub-family,—OVULINÆ*, p. 45.

Gould proposes for a minute shell from the China seas the name *Crithe*, having both ends produced and numerous cross folds on the inner lip (Proc. Boston Soc., 1860, VII, p. 384).

On page 46 I have noticed in reviewing the cretaceous species described under the name *Ovula* that there is only one species known, which appeared to be a true *Ovula*, referring to the *Ovula antiquata* of D'Orbigny from our South Indian cretaceous deposits. Having since examined the original specimen of Forbes *Cypræa Cunliffei*, I found that D'Orbigny's identification, as stated in the Prodrome, is correct, and that the species must be referred to the next sub-family; consequently there is at present no species of *ovulinæ* known with sufficient certainty from cretaceous deposits.

c. *Sub-family,—CYPRÆINÆ*, p. 47.

7. Cypræa Cunliffei, *Forbes*, Pl. IV, Fig. 1; and Pl. XXVIII, Fig. 29 (original).

1846. *Cypræa Cunliffei*, Forbes, Trans. Geol. Soc., London, VII, p. 134, Pl. XII, Fig. 22, non *Cyp. Cunliffei*, Forbes, antea, p. 55.
1847. *Ovula antiquata*, d'Orbigny, Paléont. Voy. Astrolabe, Pl. IV, Figs. 4-6.
1850. *idem.* Prodrome, II, p. 225 et auctorum.
1867. *idem.* antea, p. 47.

Prof. Forbes' original specimen, with the aperture exposed from the covering rock, has been represented on Plate XXVIII, Fig. 29. This specimen is in a beautiful state of preservation; it is apparently perfectly convolute, like an *Ovula*, but the inner lip is in its entire length toothed, the denticles being short and almost obsolete towards the anterior termination. The denticulation of the outer lip is only internally visible, being extremely fine. The surface is covered with very minute spiral striæ. The entire character of this species is exactly the same as that of the recent *Cyp. Adansoniana*, which is also externally convolute and spirally striated. It would be very interesting to break up a specimen of this rare species or to observe young specimens so as to ascertain whether the shell is really convolute or involute in the first stage. In either case I think it very probable that a new sub-genus must be formed for these shells, unless they can be referred to Troschel's *Erronea*, though it must first be known how to restrict or characterize this last one.

3. Cypræa (Luponia) Newboldi, *Forbes*, p. 54.

The dentition of the lips is beautifully clear on Forbes' original, the teeth become considerably smaller on the posterior half of the inner lip, than is usually the case in species of *Luponia*.

4. Cypræa (Luponia) carnatica, *Stoliczka*, Pl. IV, Fig. 4.

1865. *Cyp. Cunliffei*, Forbes, antea, p. 55, non *idem*, Forbes.

This species having been previously by me incorrectly identified with Forbes' *Cyp. Cunliffei* must now receive a new name.

6. Cypræa Kayei, *Forbes*, p. 56.

Forbes' original specimen of this species is a little more globose than most of ours, but the distinction does not appear to be a specific one. The dentition is distinctly traceable on both margins.

The *Cypræa bullaria*, Schlotheim, of which I received authentic specimens through Prof. Geinitz, is still more globose than the present species, having on the casts the spire usually impressed and very narrow, but it comes close to our Fig. 7 of Plate IV.

Cyp. spirata, Schloth., also from Faxoë, is quite distinct from the former, having the spire rather elevated and the aperture posteriorly strongly produced;

it somewhat resembles our *Erato Veraghoorensis* (antea, p. 59), but is decidedly less inflated.

8. Cypræa (Epona) globulina, *Stoliczka*, Pl. XXVIII, Fig. 30.

Ep. testa globata, valde inflata, ad extremitates rapide contracta atque producta, levigata; apertura angusta utrinque ad margines denticulata.

Three specimens of this new species were found among the materials left undescribed by Prof. Forbes. The species is distinguished by its globose form and the narrow aperture with finely denticulated margins; it comes very close to the recent *Cyp. (Epona) globulus*, from which it can hardly be distinguished except by the shorter denticulations of the lips.

Locality.—Pondicherry, in a light coloured sandstone; apparently rare.

Formation.—Arrialoor group.

III. *Family,—OLIVIDÆ.*

The name *Dactylus*, Klein (Ostrac., 1753, p. 77, pl. 5, fig. 91) most probably refers to an *Oliva inflata* and could be retained for this type of *olivinæ*. Several conchologists separate the three sub-families which we have mentioned into families, but this hardly produces any essential change in the general arrangement.

a. *Sub-family,—OLIVINÆ.*

Gray in his last monograph of the *Olividæ* (List of Moll. in Coll. Brit. M., pt. II, 1865, p. 7) distinguishes the following genera, *Strephona*, *Ispidula*, *Ramola*, (= *Lamprodoma*, Swainson, H. and A. Adams, Gen. II, p. 615), *Carmione*, *Claneophila*, *Galeola*, *Anazola*, *Agaronia*, *Olivina*, *Scaphula*, and *Micana*.

The *Oliva vetusta*, Forbes, has to be transferred to the next sub-family, only two known cretaceous species, therefore, of the *olivinæ* remaining.

b. *Sub-family,—ANCILLINÆ.*

The name *Ancilla*, Lam., having priority before that of *Ancillaria*, Lam., ought to be used.

Conrad adds two new genera to this sub-family;

1. *Ancillopsis*, Con., 1865 *(vide* Am. Journ. Conch., I, p. 22), referring to it species which are nearly congeneric with *Amalda*, H. and A. Adams.

2. *Tortoliva*, Conrad, 1865 *(ibid.*, p. 143); the characteristic here given scarcely differs from that of the next genus.

3. *Monoptygma*, Lea. I believe Conrad's transfer of this genus (taken in the original sense) to this sub-family is correct. In his Catalogue of Eocene shells, 1866, the author quotes four species. The genus must be struck out of the list in the family *Pyramidellidæ*.

? 4. *Olivula*, Conrad, is by H. and A. Adams considered as identical with *Ancilla*, but it may probably be applied to the transversally ribbed or rugose species.

DIPSACUS VETUSTUS, *Forbes*, sp., Pl. XXVIII, Fig. 27.

1846. *Oliva vetusta*, Forbes, Trans. Geol. Soc., London, VII, p. 134, Pl. XII, Fig. 23.

Dips. testa ovato-elongata, sub-fusiformi, levigata, suturis callositate tectis; apice acuminato; ultimo anfractu subinflato, antice truncato et late emarginato, fascia externa antice in labri margine denticulo paulo prominente disinente; labio torto, oblique multiplicato, postice levi.

Shell elongated, with an elevated and pointed spire, last whorl sub-cylindrical, very slightly inflated posteriorly; surface smooth, sutures covered by a callosity which extends upon the spire, enveloping the same to a large extent; aperture enlarged, anteriorly widely emarginated; the external band terminates on the outer lip with a small but distinct tooth, the inner lip is strongly twisted, being in nearly three-fourths of the anterior portion strongly plicated or sulcated (see Fig. 27, a), and posteriorly smooth.

The form and structure of the shell in general agrees with H. and A. Adams' sub-genus *Amalda*, but the lip is more numerously plicated as in several of the recent species of this sub-genus.

Our figure represents Forbes' original in double the natural size; the specimen has been found in beautiful preservation, after the adhering rock was removed. It is surprising how Forbes could have referred that shell to *Oliva*.

Locality.—Pondicherry, in light bluish sandstone; apparently rare, only the figured specimen having as yet been found.

Formation.—Arrialoor group.

IV. *Family*,—*DOLIIDÆ*, p. 61.

(*DOLIACEA*, Troschel, Gebiss der Schnecken, I, p. 224).

Conrad proposes a new generic name, *Doliopsis*, for a few fossil species which, judging from the figure given of *Dol. quinquecosta* in Am. Journ. Conch., I, pl. 10, fig. 15, would hardly indicate a distinction from *Dolium* proper. (See also Am. Jour. Conch., I, p. 150). *Sycotypus*, Brown (*Ficula*, Swainson, *Ficus*, Klein) would most probably be better placed in this family than be kept distinct, as *SYCOTYPIDÆ* (Troschel, Gebiss der Schnecken, I, p. 238). The tuberculated species of *Sycotypus* are sometimes difficultly separable from *Hemifusus*.

Gabb (Pal. Calif. I, pp. 105 and 211) described from the cretaceous rocks of California two species under the name of *Ficus*, one being doubtful, *F. cypræoides** (for it may be a young *Cypræa*), and the other, *F. mammillatus* apparently correctly belonging to *Sycotypus*.

In the Check list of eocene fossils of N. America, 1866 (pp. 15-16), Conrad quotes in the family "*SYCOTYPIDÆ*" the following species from the lower eocene beds which are by others considered to be of cretaceous age; *Perissolax Gabbii* (*Fusus Remondii*, Gabb); *Ficopsis Cooperii* (Gabb) Conrad; *Ficop. modestus*, C.; *Ficop. mammillatus* (*Ficus id.*, Gabb); *Ficop. penitus*, Conr.; *Ficop. Remondii*,

* Mr. Gabb writes (June 1868) that he intends to propose a new genus for this species.

Gabb; *Priscoficus Hornii*, Gabb; *Pric. oregonensis*, Con., and *Pris. Smithii?* Sowerby.

The genus *Perissolax*, as pointed out by Gabb, appears better classified in the FUSINÆ of the *Muricidæ*. The new genera *Ficopsis* and *Priscoficus* appear to include a varied number of different shells, and unless the type species of these supposed new genera are pointed out they seem to be worthless. Originals of *Pyrula Smithii*, Sow., which I have examined in London, show that the species is a *Rapa*.

V. *Family,—CASSIDIDÆ*, p. 61.

(CASSIDEA, Troschel, Geb. d. Schnecken, I, p. 220).

The genera composing this family are *Cassis*, *Semicassis*, *Phalium*, *Galeodea* (Link. or Linn.? *Cassidaria*, Lam.)., *Oniscia*, *Pachybatron*.

In Am. Jour. Conch., I, 1865, p. 26, is a *Galeodaria*, Conrad, quoted as sub-genus of *Galeodea*, and besides *Morum*, Bolten, distinguished as a separate genus.

In Check list of eocene fossils (Smiths. Mis. Coll., No. 200, 1866, p. 15) Conrad quotes from his lower eocene rocks (cretaceous?) *Galeodea petrosa*, Con., *Semicassis? biliratus* and *Semic.? petrosus*, Con.; the two last named species are apparently the same which the author has placed in Am. Jour. Conch., I, 1865, p. 150, in his genus *Doliopsis*, mentioned in the former family.

VI. *Family,—PLEUROTOMIDÆ*, p. 63.

(PLEUROTOMACEA, Troschel, Geb. d. Schnecken, II, 1866, p. 38).

Numerous new genera and higher sub-divisions have been lately distinguished in this family.

A. Adams describes in Ann. mag. nat. hist., Ser. III, VI, p. 331, and XV, p. 322, the new genera *Zafra*, *Mitromorpha*, and *Cytharopsis*.

Conrad describes a genus, *Moniliopsis*, in Am. Jour. Conch., I, 1865, p. 143, and another one as *Cochlispira*, *ibid.*, p. 210.

Stimpson (Am. Jour. Conch., I, p. 62) proposes, after having observed the animal of one of the species, to establish for the genus *Clionella*, Gray, a distinct family, CLIONELLIDÆ. The lateral teeth resemble those of *Pleurotoma* and *Halia*, but there is besides a central tooth present. The author considers this distinction sufficient to refer the CLIONELLIDÆ to a distinct sub-order from the TOXOGLOSSATA under the name of TOMOGLOSSATA!

Conrad in Am. Jour. Conch., I, p. 20, quotes in the family PLEUROTOMIDÆ also the genera *Exilia*, Conr., *Eucheilodon*, Gabb, and *Scabinella*, Conr.

The name *Cithara*, Klein (Ostr., 1753, p. 97, pl. V, fig. 105) refers to *Harpa minor*.

Dr. v. Koenen ("Ueber *Conorbis* and *Cryptoconus*," Marburg, 1867) proposes for some fossil species the name *Cryptoconus*, an intermediate form between *Conus* and *Conorbis* of Swainson; there seems, however, great difficulty in distinguishing *Cryptoconus* from the last named form.

VIII. *Family,—VOLUTIDÆ*, p. 74.

a. *Sub-family,—MARGINELLINÆ*, p. 75.

(*Marginellacea*, Troschel, Geb. d. Schnecken, II, 1868, p. 57).

Stimpson proposed the name *Cysticus*, and a distinct family *Cysticidæ*, for a shell very closely allied to a *Marginella*, *Cyst. capensis*, but the animal and especially the dentition are somewhat different. Troschel (loc. cit.) accepts the genus in the *marginellinæ*.

b. *Sub-family,—VOLUTINÆ*, p. 77.

(*Volutacea*, Troschel, Geb. d. Schnecken, II, 1868, p. 54).

Meek in his Check list of N. American cretaceous Mollusca (1864, p. 21) quotes six species of *Volutilithes*, seven species of *Voluta*, and five species of *Rostellites*.

Conrad (Am. Jour. Conch., II, 1866, p. 66) characterizes a new genus *Volutifusus*, describing the species *Vol. typus* a miocene shell from N. Carolina, which is, I believe, generically identical with *Athleta*, Con., see p. 90. The *Vol. Tuomeyi* ought not to be referred to *Athleta*.

In Check list of eocene fossils (Smiths. Misc. Coll., No. 200, p. 16), the same author quotes three species of *Volutilithes* from the lower eocene, referred to the cretaceous formation by other geologists. He also quotes several species of the genera *Caricella* and *Otocheilus*, which have been mentioned already in Am. Jour. Conch., 1865, I, p. 24.

Ficulopsis Pondicherriensis, *Forbes*, sp., p. 85.

In young specimens the striæ of growth are quite straight along the suture, and the spire is comparatively higher than in old ones.

Page 86, third line, from below note that *Mitra Murchisoni*, Müller, is identical with *Fulguraria elongata*.

Genus XVIII. VOLUTILITHES, *Swains.*, p. 92.

1. Volutilithes septemcostata, *Forbes*, sp., Pl. IX, Figs. 1 and 2.

1846. *Voluta septemcostata*, Forbes (Trans. Geol. Soc., London, VII, p. 131, Pl. XII. Fig. 3).
1867. *Volutilithes latisepta*, Stoliczka, *vide* antea, p. 93.

Upon examination of Forbes' originals I found both species to be identical; the original specimen shows all the transverse striæ of equal strength, not unequal as in Forbes' figure; there are four ribs visible on the last and five on the penultimate whorl.

c. *Sub-family,—VOLUTOMITRINÆ*, p. 100.

The only other cretaceous species of *Volutomitra* is *Mitra pyruliformis*, Müller (Petræf. Aach. Kreidef., II, 1851, p. 23, pl. 3, fig. 25), which is identical with *Pyrula Binkhorsti* of the same author (Suppl. 1859, p. 26, pl. 8, fig. 10).

Volutomitra pyruliformis differs from our *Vol. canaliculata* in having the posterior edge of the whorls constricted, not regularly canaliculated.

c. *Sub-family,—MITRINÆ*, p. 101.

Mitroidea, Pease, Proc. Zool. Soc., 1864, p. 514, is characterized as a new genus, distinguished by an anteriorly truncated columella with numerous folds. Another form is described in Am. Jour. Conch., III, 1867, p. 211, as *Mitropsis*, by the same author.

Conrad quotes several species of *MITRINÆ* (Am. Jour. Conch., I, 1865, pp. 24 and 25, and subsequently in other publications) as *Lapparia*, Con., *Fusimitra*, Con., *Conomitra*, Con., and others.

IX. *Family,—FASCIOLARIIDÆ*, p. 105.

a. *Sub-family,—TURBINELLINÆ*, p. 105.

Mazalina, Con., Am. Jour. Conch., 1865, I, p. 23.

b. *Sub-family,—FASCIOLARIINÆ.*

(*FASCIOLARIACEA*, Troschel, Geb. d. Schnecken, II, p. 60).

Stimpson (Am. Jour. Conch., I, 1865, p. 59), proposes a distinct family, *PTYCHATRACTIDÆ*, for a new genus, *Ptychatractus*, the species *Pt. ligata*, Mighels, having a shell and operculum like *Fasciolaria*, but the dentition is said to resemble that of the *PURPURIDÆ*. I am afraid there will be no end of families necessary if they are to be based solely upon the dentition of the animals.

Conrad (Am. Jour. Conch., 1867, III, p. 186) proposes a name *Fasciolina* for a species with only one median columellar plait, but of fusiform shape, like *Fasciolaria*. *Voluta (Volutilithes) acuta*, Sow., from the Gosau-deposits has probably to be placed in this genus, as it has only one but rather anterior columellar fold.

Laube (Denksch. Akad., Wien, 1868, vol. XXVIII, Fauna der St. Cassian-Schichten, p. 32) has two interesting species from triassic beds, *Fasciolaria Karreri* and *Fasc. avena*, Laube; both these species much resemble in the formation of the anterior folds of the columella some of the *CANCELLARIIDÆ*, especially *Merica* and *Narona*.

Meek (Check list cret. fossils of N. America, 1864, p. 21) quotes in the family *FASCIOLARIIDÆ* the following four species, *Fasciol. buccinoides*, Meek and H., *F. cretacea*, M. and H., *Fasc. Saffordi* and *Slackii*, of Gabb.

Page 107 (for XXII) read XXIII, LATIRUS, Montfort, 1810.

X. *Family,—MURICIDÆ*, p. 111.

Stimpson in Am. Jour. Conch., I, 1865, p. 56, remarks that the *FULGURINÆ* and even the genus *Fusus* (as restricted) of the *FUSINÆ* belong to the *FASCIOLARIIDÆ*, while *Neptunea* and its allies belong to the *BUCCINIDÆ*; the family ought thus to

be restricted to the group of shells called *Murex*. But the species referred to *Eupleura* by H. and A. Adams are said to be closely allied to the *Muricidæ*.

A new genus has been proposed (*ibid.*, p. 58) for *Fusus cinereus*, Say, under the name of *Urosalpinx*.

a. *Sub-family,—FULGURINÆ*, p. 112.

Ecphorea, Con., Am. Jour. Conch., II, 1866, p. 75, appears to belong to this sub-family.

Gill published several valuable notes "on the genus *Fulgur* and its allies" (Am. Jour. Conch., III, 1867, p. 141), agreeing with Stimpson that this sub-family belongs to the *Buccinidæ*. The following genera are distinguished by that author, *Fulgur*, Montf., *Sycotypus*, Gill ex Browne, *Tudicla*, Link ex Bolten. Conrad publishes (*ibid.*, p. 182) a Synopsis of the genera *Sycotypus* and *Busycon*, adding (loc. cit., p. 184) a new sub-genus, *Sycopsis*, for the tuberculated but not canaliculated species. *Tortifusus*, Conrad (*ibid.*, p. 187) also belongs to this sub-family.

XXV. HEMIFUSUS, *Swainson*, p. 113.

1. Hemifusus cinctus, *Forbes*, sp., Pl. X, Figs. 17 and 18.

1846. *Voluta cincta*, Forbes, Trans. Geol. Soc., London, VII, p. 132, Pl. XII, Fig. 6.

My suggestions regarding this species were fully confirmed. There are in the London Geological Society's Collections at present three specimens of this species. The original has the shell very well preserved, but it had the aperture covered up by the rock. Upon removing this I found that there is no trace of any columellar folds, and Forbes must evidently have been mistaken in supposing that the spiral striæ continue internally as folds; he could not have observed them. The two other specimens are casts, but neither of them shows a trace of columellar plaits.

b. *Sub-family,—FUSINÆ*, p. 115.

(*Fusacea* in parte, Troschel).

In the proposed family *Fusidæ* Conrad quotes (Am. Jour. Conch., I, p. 16, etc.) the following additional new genera, *Papillina*, *Levifusus*, *Lirofusus*, *Bulbifusus*, *Exilifusus*, and in Check list eocene fossils, 1866, p. 19, *Clavifusus*, *Turrispira*, and *Priscofusus*. If the fossil shells upon which these genera are based were always perfectly well preserved somebody else, besides their author, would be able to recognize their characters, but as matters stand now it is hardly possible to trace out the signification of one-half of those so-called new genera.

Siphonalia, A. Adams, Ann. mag. nat. hist., 1863, XI, p. 202.

4. Tritonidea Trichinopolitensis, *Forbes*, sp., p. 126.

In the original specimen of Forbes the last varix is very distinctly thickened, resembling that of a *Tritonium*; the species is, however, a true *Tritonidea*.

Fusus Buchi, Müller, from the Senonien deposits of Aachen only differs by a somewhat larger number of transverse ribs.

c. *Sub-family,—MURICINÆ.*

The genus *Odontopolys*, Gabb (Am. Jour. Conch., I, 1865, p. 16) is placed by Conrad in this sub-family, but judging from the form of the type-species *O. compsorphytis* (Jour. Ac. N. Sc. Phil. IV, pl. 67, fig. 16), the genus appears to be closely allied to *Hindsia*.

Murex fluctuosus, Forbes, mentioned on p. 129, is represented in the Geological Society's Collection only by the figured fragment, probably belonging to some species of *Tritonidea*; it is distinct from any of the species described by me.

Meek (List of North Amer. cret. fossils, 1864, p. 22) mentions *Clavellithes* (or *Piestocheilus*), *Pyrifusus*, *Tritonifusus*, and others. He quotes 32 North American cretaceous species belonging to the *MURICIDÆ*.

XI. *Family,—TRITONIIDÆ*, p. 130.

(*RANELLACEA* and *TRITONIACEA* of Troschel).

Valenciennes proposed (Compt. rendus, 1858, p. 762) the name *Tritonellium* in place of *Tritonium*, Müller, 1776 (Lamk., 1807), so as to prevent mistaking it for *Tritonia*, Cuv., 1798, but this change is not necessary.

The American Conchologists have largely added to the number of this family.

Trachytriton, Meek (Check list cret. fossils, N. Am., 1864, p. 37) has been proposed for *Fusus? vinculum*, Hall and Meek, being a bucciniform, rather thin shell, the canal nearly straight, columella smooth; surface without distinct varices; this genus appears closely allied to *Hindsia*, the principal distinction being a smooth lip.

Conrad quotes (Am. Jour. Conch., I, 1865, p. 20) *Buccitriton*,* *Tritonopsis*, *Personella*, *Sanellina*, *Sagenella*, and in Check list eocene fossils of 1866 (p. 17) *Ranellina*.

Tritonium cretaceum, Müller, p. 133; the original has the outer lip broken away, but it probably belongs to *Epidromus*.

Triton atavus, Forbes, p. 134, is founded upon a hopeless cast, possibly belonging to *Cerith. vagans*.

Fusus pedernalis, Römer, p. 134, is determined from an impression left on a *Gryphæa*.

XXVIII (instead of XXXI). HINDSIA, *Adams*, 1850, p. 135.

For the consecutive numbers of the genera see Appendix B.

XII. *Family,—COLUMBELLIDÆ.*

Mörch (Jour. Conch., VII, p. 254) divides the old genus *Columbella* according to the dentition into *Pygmæa*, Humph., *Milsella*, Risso, and *Pyrena*, Bolt., each with a number of sub-genera. We would be disposed to retain those sub-genera as genera, but the generic names, referred to, cannot be introduced in that author's sense.

Meta, Reeve, is an intermediate form between *Stromboidea* and *Conella*; typical species are *Conus macrostomus*, Anton, *Con. Dupontiæ*, Kiener, and others.

* This probably belongs to the *NASSINÆ*.

Aesopus, Gould (Proc. Bost. Soc., 1859, VII, p. 383) is said to be an intermediate form between *Mitra* and *Columbella*.

Alcira, Adams (Proc. Zool. Soc., 1859, p. 450) differs from *Columbella* by having one distinct anterior fold on the columella which is truncated.

XIII. *Family,—BUCCINIDÆ*, p. 140.

(*Fusacea in parte* and *Nassacea* of Troschel).

The family *Buccinidæ* no doubt contains an assemblage of various shells, but if we are to follow the classification of the species of this family, as also of that of the *Muricidæ*, *Columbellidæ* and others, according to the few instances in which the dentition of the radula has been examined, the characters of the shell would become worthless. I cannot believe that this kind of classification can be carried out so thoroughly regardless of the form of the shell, though genera like *Neptunea* are perhaps quite as much allied to *Buccinum* as they are to *Fusus* or *Pollia*.

b. *Sub-family,—NASSINÆ*, p. 140.

Ilyanassa n. gen., Stimpson (Am. Jour. Conch., I, 1865, p. 61).

Buccitriton, Conrad, mentioned in the *Tritonidæ*, appears to belong to this sub-family, at least so far as the species *B. altum*, Con., is concerned (see Am. Jour. Conch., I, 1865, p. 211, pl. 21, fig. 9).

c. *Sub-family,—COMINELLINÆ*, p. 141.

Lævibuccinum, Con., (Am. Jour. Conch., I, 1865, p. 211) appears to belong to this sub-family, if not to the *Columbellidæ*.

d. *Sub-family,—BUCCININÆ*, p. 142.

Genus, *Buccinum*—note the following;

Fischer and Mörch consider *Volutoharpa* to be a good genus, not only a subgenus of *Buccinum;* several species are described in Jour. d. Conchiliologie, VII., p. 40.

Ptychosalpinx, Gill, 1867 (Am. Journ. Conch., III, p. 153) is allied to *Pollia*, but placed in this sub-family by its author.

XIV. *Family,—PURPURIDÆ.*

H. Adams proposes for *Vexilla fusconigra*, Pease (Proc. Zool. Soc., Lond., 1859, p. 328) the name *Usilla* (*ibid.*, p. 369).

Galeropsis, Hupé, 1859, is a link between *Coralliophila* and *Pedicularia;* *G. Lavenayanus* is a fossil species (Revue et Mag. Zool., X, p. 125).

Phychatractus, Stimpson, 1865 (Am. Journ. Conch., I, p. 59), mentioned in the family *Fasciolariidæ*, is said to be, according to its dentition, allied to species of this family.

Conrad (Am. Journ. Conch., I, p. 21) quotes several species of *Lacinia*, and *Cornularia* of Conrad.

11. *Rapa Monheimi*, Müller, mentioned on page 148, is a *Hemifusus*, and ought to be transferred to the sub-family *FULGURINÆ*.

XV. *Family*,—*TRICHOTROPIDÆ*, p. 157.

Fischer (Journ. Conch., 1864, p. 252) calls the species *Trich. borealis*, *Ariadnæ*.

XVI. *Family*,—*CANCELLARIIDÆ*, p. 160.

(*CANCELLARIACEA*, Troschel, Geb. d. Schnecken, II, p. 45).

Troschel states that according to the dentition of the species *Canc. crenifera*, Sow., the family belongs to the TOXOGLOSSA. He also proposes to distinguish *Admete* as a distinct family, *ADMETACEA*.

Babylonella, Conrad, see Am. Journ. Conch., I, 1865, p. 32, is stated to be a sub-genus of *Cancellaria*.

XVIII. *Family*,—*PYRAMIDELLIDÆ*, p. 171.

The genus *Monoptygma*, as restricted for the species for which Lea originally proposed his name, has to be transferred from this family to the *OLIVIDÆ*, see p. 60 and p. 451.

In Proceedings Linn. Soc., vol. VII, p. 1, etc., A. Adams described several new generic forms of *PYRAMIDELLIDÆ* as *Mormula*, *Miralda*, *Pyrgulina* and *Mumiola* and a number of new species of *Parthenia*, Lowe. The same author characterizes (Ann. mag. nat. hist., 1860, V, p. 406) *Stylopsis* as allied to *Eulimella*.

Another allied genus is *Scalænostoma*, Desh., principally differing by a keel at the middle of the last whorl (Conch. de l'ile de la Réunion, etc., 1863, Moll., p. 58, pl. VII, figs. 26-28); the type species, *Sc. carinatum*, Desh., is here described.

Several new species of *Nerinea* are described in Guéranger's "Album paléont.," etc., 1867, and by Fraas in the Würtemb. Jahreshefte, vol. XXIII, 1867, p. 240, etc.; the last are from Palestine.

Globiconcha elongata, d'Orb., from the Caucasus is based upon a specimen of *Itieria abbreviata*, Phil. sp.

I have seen a very fine specimen of a *Syrnola*, n. sp. in the collection of Dr. Bosquet at Maestricht; it was procured from the Aachen Greensand.

XX. *Family*,—*CERITHIIDÆ*, p. 186.

CERITHIUM SPHÆRULIFERUM, *Forbes*.

This species described by Forbes in Trans. Geol. Soc., London, VII, p. 125, pl. XIII, fig. 6, from Pondicherry appears to be distinct from those previously noticed; it has only three rows of larger, rather rounded tubercles, of which the

posterior sutural ones are the strongest; the intermediate tubercles being much smaller. The species resembles in other respect *Cerith. Arcotense*, but its whorls appear to be broader in proportion.

CERITHIUM SCALAROIDEUM, *Forbes*, p. 201.

On p. 202, line three from above, add the following note after the word Norfolk,—*Cerith. reticulatum* referred to in Woodward's Geology of Norfolk, is a sub-fossil or living species; its form is much more slender than that figured by Reuss and quite distinct from the cretaceous species.

13. CERITHIUM TRICHINOPOLITENSE, *Forbes*, Pl. XVI, Fig. 5, and Pl. XIX, Fig. 4.

1867. *Cerithium (Sandbergeria) antecedens*, Stol., antea p. 202.

The examination of Forbes' original has shown that both are identical. Forbes' figure is rather insufficient, showing the spiral striation indistinctly. There are from 3 to 5 stronger spiral striæ with some smaller ones between them.

A large number of new species belonging to *Cerithium* are figured by Guéranger in his Album paléont., 1867.

XXI. *Family,—MELANIIDÆ.*

With regard to a large number of interesting species and genera belonging to this and allied families the American Journal of Conchology and Journal of Academy of Natural Sciences of Philadelphia ought to be consulted.

XXXVI. *Family,—RISSOIDÆ.*

P. 277. *Rissoa Bosqueti*, Müller (Suppl. to Petræf. Aachner Kreidef., 1859, p. 21, pl. 8, fig. 9) ought to be mentioned here.

XXXVII. *Family,—EULIMIDÆ.*

P. 288. *Euchrysalis.* Having since obtained a more detailed account of this new genus of Laube I would only draw attention to the very elongated form of some of the triassic species; the aperture is almost in all very small and pointed on both ends (see Denksch. Akad., Wien, 1868, XXVIII, pt. III, p. 41).

XXXVIII. *Family,—NATICIDÆ.*

P. 295. *Ptychostoma*, Laube (*ibid.*, p. 17). It seems a little doubtful whether this genus will stand as it was instituted. The type species *Pt. pleurotomoides* (not *pleuratomoides*) as also *Pt. gracile* very much resemble *Scalænostoma*, Desh. (*PYRAMIDELLIDÆ*, see p. 459) and the third species *Pt. Sanctæ-crucis* appears to be closely allied to *Neritoma*, Morris (see p. 337).

APPENDIX, B.

The species which are identical with those from cretaceous deposits of Europe and other countries are marked with an asterisk.

Abbreviations of groups or formations in the Indian cretaceous series—

Arr.=Arrialoor; Trich.=Trichinopoly; Oot.=Ootatoor; Val.=Valudayur; Ver.=Verdachellum.

Abbreviations of names of localities—

And.=Andoor; Alund.=Alundanapooram; Anap.=Anapaudy; Arr.=Arrialoor; Comar.=Comarapolliam; Coon.=Coonum; Cooth.=Coothoor; Cum.=Cumalipooram; Garud.=Garudamungalum; Kar.=Karapaudy; Kol.=Koloture; Kolak.=Kolakonuttom; Kull.=Kullygoody; Kun.=Kunanore; Kurr.=Kurribiem; Mongl.=Monglepaudy; Mor.=Moraviatoor; Mull.=Mulloor; Ninn.=Ninnyoor; Null.=Nulloor; Od.=Odium; Oot.=Ootatoor; Parch.=Parchairry; Pond.=Pondicherry; Purav.=Puravoy; Serag.=Seraganoor; Serd.=Serdamungalum; Shill.=Shillagoody; Shut.=Shutanure; Vait.=Vaitagoody; Ver.=Veraghoor; Vyl.=Vylapaudy.

N. B.—Genera and species are numbered consecutively; the former in Roman, the latter in Arabic numbers.

No.	GENERA & SPECIES.	REFERENCES.		INDIAN.		NOT INDIAN.		REMARKS.
		Page.	Plate & Fig.	Locality.	Group.	Locality.	Group.	
	PULMONATA.	6 & 447						
	Stylomatophora.	6						
	HELICIDÆ.	,,						
	HELICINÆ.	,,						
I	ANGYSTOMA, *Klein*, 1753.	8 & 447						
1	—Cretaceum, *Stol.* ...	9	I, 1-5	Comar., Ninn. &c.	Arr.			
2	—Arrialoorense, *Stol.* ...	10	I, 6	Ninn. ...	Arr. ...	...	...	Very like the recent *H. Nilgirica.*
3	—Arcotense, *Stol.* ...	11	I, 7	Alund. ...	Trich.			
II	MACROCYCLIS, *Beck.*, 1837.	12						
4	—carnatica, *Stol.* ...	12	I, 8	Ver. ...	Arr.			
	PROSOBRANCHIA.	13 & 447						
	Ctenobranchiata.	13						
	Siphonostomata,	14						
	ALATA.	15						
III	PUGNELLUS, *Conrad*, 1860.	18						
5	—contortus, *Sow.* ...	19	III, 1-5	Alund., Kolak., &c.	Trich.			
6	—granuliferus, *Stol.* ...	21	III, 6-8	Kolak., And., Serd.	Trich. & Arr.			

No.	GENERA & SPECIES.	References.		Indian.		Not Indian.		REMARKS.
		Page.	Plate & Fig.	Locality.	Group.	Locality.	Group.	
III	PUGNELLUS,—*contd.*							
7	—uncatus, *Forb.* ...	22	III, 9-13	Parch., Kull., &c.	Trich.&Arr.			
IV	APORRHAIS, *Petiver*, 1711.	23 & 447						
8	—Arrialoorensis, *Stol.*...	28	II, 1	Comar. ...	Arr.			
9	—securifera, *Forbes* ...	28	II, 2-4	Kolak., Serd., And., &c.	Trich.&Arr.			
V	ALARIA, *Morr. & Lyc.*, 1854.							
*10	—Parkinsoni, *Mant.* ...	30	II, 5-8	Od., Mor., Mongl.,&c	Oot.&Trich.	Blackdown, Folkstone, Pert. du Rhone.	Gault. Gr. Sand.	Low. Plæner of Germany, Cenomanien.
*11	—papilionacea, *Goldf.* ...	31	II, 9, 10	Anap., And., Coon., Null., &c.	Trich.&Arr.	Sax., Bohemia & Nth. Germany.	Turon-beds.	(Middle Plæner).
12	—glandina, *Stol.* ...	32	II, 14, 15	Alund., Anap.	Trich.			
13	—acicularis, *Stol.* ...	32	II, 16, 17	Olap. ...	Arr.			
14	—tegulata, *Stol.* ...	33	II, 11-13	And., Kolak., Serd., Comar., &c.	Trich.&Arr.			
VI	ROSTELLARIA, *Lamk.*, 1799.	23						
15	—palliata, *Forb.* ...	34	II, 18-20	Serd., Mull., Arr., Olap., &c.	Trich.&Arr.			
VII	PTERODONTA, *d'Orb.*	35 & 292						
16	—? terebralis, *Stol.* ...	42	V, 6-8	Od.& Parch.	Oot.			
	CYPRÆIDÆ.	44 & 448						
	OVULINÆ.	45 & 449						
	OVULA, *Brug.*, 1792...	46						
	CYPRÆINÆ.	47						
VIII	CYPRÆA, *Linné.* ...	51						
17	—(Luponia ?) Cunliffei, *Forb.*	47 & 450	IV, 1 & XXVIII,29	Arr., Pond.	Arr.			
18	—(Aricia) ficulina, *Stol.*	53	IV, 11, 12	Alund., Kull.	Trich.			
19	—(Luponia) pilulosa, *Stol.*	53	IV, 5	Mor. ...	Oot.			
20	— —Newboldi, *Forb.*	54 & 450	IV, 2, 3	Kull., And.	Trich.			
21	— —carnatica, *Stol.* (*C. Cunliffei*, Forb.).	55 & 450	IV, 4	Veragh....	Arr.			

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*23	—Kayei, *Forb.* ...	56& 450	IV, 7-10	And., Serd., Arr.	Trich.&Arr.	Prov. Charente.	Campanien of Coquand.	Senonien of d'Orb.
24	—(Epona) globulina, *Stol.*	451	XXVIII, 30.	Pond. ...	Arr.			
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XVI	MELO, *Humph.*, 1797	83						
33	—pyriformis, *Forb.* ...	83	VI, 9	Kull.,Pond.	Trich.? Valud.			
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34	—Pondicherriensis, *Forb.*	85& 454	VI, 10, 11	Ditto.	Ditto.			
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36	—multistriata, *Stol.* ...	89	VIII, 1-3	Anap. ...	Trich.			
XIX	ATHLETA, *Conrad*, 1860.	90						
37	—purpuriformis, *Forb.*	91	VIII, 4, 5, 6, 7	Pond.,Kull. Ver., &c.	(? Val.) & Trich.			
38	—scrobiculata, *Stol.* ...	92	VIII, 8	Kull. ...	? Trich.			
XX	VOLUTILITHES, *Swains.*, 1831.	92						
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40	—accumulata, *Stol.* ...	94	IX, 3, 4	Olap., Anap., &c.	Trich.			
41	—muricata, *Forb.* ...	94	IX, 5	Kull. ...	Trich.?			
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XXVI	FASCIOLARIA, *Lam.*, 1792.	108						
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*51	—rigida, *Baily* ...	109	X, 10-16	And., Coon., Shut., &c.	Trich. ...	Cretaceous deposits, probably Cenoman. of South Africa.		
52	—assimilis, *Stol.* ...	110	X, 5-7	Olap., Com.	Arr.			
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56	—excavata, *Blanf.* ...	121	XI, 1-3	Kun., Anap., Serd., &c.				
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59	—Requieniana, *d'Orb.*	124	XI, 8, 9	Anap., Ver.	Trich. ...	Mans, Uchaux.		
60	—granulata, *Stol.* ...	125	XI, 6, 7	Parch. ...	Trich.			
61	—Trichinopolitensis, *Forb.*	126 & 456	XI, 4	Alund., Olap.	Trich.			

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70	—Arrialoorensis, *Stol.*...	144	XII, 3	Vait., Kar., &c.	Arr.			
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XXXVIII	PSEUDOLIVA, *Swains.*, 1840.	142						
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XL	RAPA, *Klein*, 1733 ...	152						
73	—Andoorensis, *Stol.* ...	153	XII, 9	And., Coon., &c.	Trich.			
74	—nodifera, *Stol.* ...	153	XII, 10,11	And., Coon., &c.	Trich.			
75	—cancellata, *Sow.* ...	154	XII, 12-16 XIII, 1-4	And., Anap., Alund., &c.	Trich.			
76	—corallina, *Stol.* ...	155	XIII, 5	Ninn. ...	Arr.			
XLI	RAPANA, *Schum*, 1817.	156						
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82	—intercedens, *Stol.* ...	164	XIII, 13	Comar. ...	Arr.			
83	—Camdeo, *Forb.* ...	165	XIII, 14	Comar. and Pond.	Arr.			
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88	—Blanfordiana, *Stol.* ...	184	XIV, 4-6	Mor. ...	Oot.			
89	—sp. indet.	185	XIV, 7	Mor. ...	Oot.			
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*91	—inauguratum, *Stol.* ...	193	XV, 15, 19, 20.	Comar., Serag., &c.	Trich. & Arr.	'Craie pisolitique,' near Paris.		
92	—hispidulum, *Stol.* ...	194	XV, 16, 17, 18.	Serd., Kol., &c.	Trich. ...	...	...	Resembles *C. hispidum*, Zek., from the Gosau deposits.
93	—limbatum, *Stol.* ...	194	XV, 13, (14).	Cooth. ...	Arr.			
94	—carnaticum, *Stol.* ...	195	XVI, 1, 2	Ver. ...	Arr.			
95	—vagans, *Stol. (?Triton atavus, Forb.?)*	196	XVI, 3, 4	Garud., Kar.	Trich. & Arr.			
96	—sphæruliferum, *Forb.*	459	...	Pond. ...	Arr.			
*97	—Arcotense, *Stol.* ...	197	XV, 2-5	Anap., Ver., &c.	Arr. ...	'Craie pisolitique,' near Paris.		
98	—lassulum, *Stol.* ...	198	XV, 8; XIX, 1.	Vyl. ...	Arr.			
99	—clarandum, *Stol.* ...	198	XV, 10	Anap. ...	Trich.			
*100	—trimonile, *Mich.* ...	199	XV, 9; XIX, 2, 3.	Kar., Comar.	Arr. ...	France and England.	Gault.	
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102	—*(Exelissa)* scalaroideum, *Forb.*	201	XV, 6, 7	Alund., Comar., &c.	Trich. & Arr.			
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104	—(—?) crispicans, *Stol.*	203	XVI, 6-8	E. of Alund., Arr.	Arr.			

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107	—(—) Pondicherriensis, *Forb.*	217	XVI, 18, 19, XIX, 8.	Pond. ...	Arr.			
108	—(—) gemina, *Stol.* ...	218	XVI, 10, 11, XIX, 9.	Arr., Kar.	Arr.			
109	—(—) dispassa, *Stol.* ...	218	XVI, 13, 14, XIX, 10, 11.	Arr. ...	Arr.			
*110	—(—) affinis *Müll.* ...	219	XVII, 17, 18, XIX, 12, 13.	Coon., Ver.	Trich. ...	Aachen ...	Senonien.	
*111	—Neptuni, *Münst.* ...	220	XVI, 16, XIX, 14.	Alund. ...	Trich. ...	Saxony, Bohemia, &c.	Turonien...	(Middle Plæner of Germany).
112	—elicita, *Stol.* ...	221	XIV, 3, XIX, 15, 16.	Ninn. ...	Arr.			
113	—contumescens, *Stol.* ...	221	XVI, 17, XIX, 17.	Comar. ...	Arr.			
*114	—? nerinea, *Röm.* ...	222	XVI, 15, XIX, 18, 19.	Od. ...	Oot. ...	Saxony, Aachen, &c.	Senonien.	Oberer Quadermergel, (Upper Plæner).
*115	— nodosa, *Röm.* ...	222	XVII, 7, XIX, 20, 21.	Od. ...	Oot. ...	Saxony ...	Cenomanien.	Unt. Quadersandstein, (Low. Plæner).
*116	—(Zaria) multistriata, *Rss.*	224	XVII, 8-14 & 16.	Garud., Comar., Kar., &c.	Trich. & Arr.	Saxony & Bohemia, & Gosau, &c.	Turonien...	Plænerkalk (Middle Plæner).
117	—(—) ventricosa, *Forb.*	227	XVII, 15, XIX, 22, 23.	Ninn. ...	Arr.			
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130	—Kurribiemse, *Stol.* ...	256	XIX, 30	Kurr. ...	Arr.			
131	—Karapaudiense, *Stol.*	256	XX, 1-4	Kar., Arr., &c.	Arr.			
132	—Vylapaudiense, *Stol.*..	257	XX, 5, 6	Vyl., Olap., &c.	Arr.			
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135	—crassitesta, *Stol.* ...	265	XX, 16, 17	Comar. ...	Arr.			
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137	—acicularis, *Stol.* ...	266	XX, 9, 10	Anap., Garud., &c.	Trich.			
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153	—Ootatoorense, *Stol.* (*Pterodonta Ootatoorensis*, antea.)	43& 488	V, 1 & 3	Od., Mor., Mongl.	Oot.			
	NATICINÆ.	294						
LXVIII	AMAUROPSIS, *Mörch*, 1857.	294						
154	—pannucea, *Stol.* ...	299	XXI, 10, XXII, 1.	Anap.,And., Kar., &c.	Trich.&Arr.			
LXIX	AMPULLINA, *Lam.*, 1813.	295						
*155	—bulbiformis, *Sow.* ...	300	XXI, 11-15	Kol., Mor., Garud., And., Comar.,&c.	Oot., Trich., Arr.	Sth. France Gosau, Aachen, &c.	Turonien & Senonien.	
156	—sortita, *Stol.* ...	301	XXIII, 2,3	Ninn.	Arr.			
LXX	EUSPIRA, *Ag.*, 1837,..	296						
157	—pagoda, *Forb.* ...	301	XXI, 7 & 8	Between And. & Ver.	Arr.			
158	—Indrana, *Stol.* ...	302	XXII, 15	Anap. ...	Trich.			

No.	GENERA & SPECIES.	References.		Indian.		Not Indian.		REMARKS.
		Page.	Plate & Fig.	Locality.	Group.	Locality.	Group.	
LXX	EUSPIRA,—*contd.*							
*159	—rotundata, *Sow.* ...	303	XXI, 9	Comar. ...	Arr. ...	England...	Greensand	Cenomanien.
160	—spissata, *Stol.* ...	303	XXII, 3-4	Kolak. ...	Oot.			
*161	—lirata, *Sow.* ...	303	XXII, 2	Ninn. ...	Arr. ...	France, Gosau, Hungary, Palestine, &c.	Turonien & Senonien.	
162	—Mariæ, *d'Orb.* ...	304	XXII, 6-8	Garud., Kull.	Trich.			
LXXI	GYRODES, *Con.*, 1860	297						
163	—pansus, *Stol.* ...	305	XXII, 9-13	Od., Mor., Serd., Vyl., Comar., &c.	Oot., Trich., Arr.	...	...	Closely resembles some forms of *Nat. canaliculata* from the German Plæner deposits.
164	—tenellus, *Stol.* ...	306	XXI, 14	Anap., Malvoy, &c.	Trich. and Arr.			
LXXII	MAMMILLA, *Schum.*, 1817.	297						
165	—edura, *Stol.* ...	306	XXIII, 1	Ninn. ...	Arr.			
166	—carnatica, *Stol.* ...	307	XXII, 5	Betw. And. & Ver., &c.	Arr.			
	VANIKORIDÆ.	307						
LXXIII	VANIKORO, *Quoy and Gaim.*, 1832.	307						
167	—munita, *Forb.* ...	309	XXII, 16	Od. ...	Oot.			
LXXIV	NERITOPSIS, *Grat.*, 1832.	309						
168	—crassa, *Stol.* ...	310	XXIII, 7	Od. ...	Oot.			
	VELUTINIDÆ.	311						
LXXV	NATICINA, *Gray*, 1842	312						
169	—ornata, *Stol.* ...	314	XXIII, 6	Arr. ...	Arr.			
LXXVI	VELUTINA, *Flem.*, 1820.	313						
170	—orientalis, *Stol.* ...	314	XXIII, 4	Comar. ...	Arr.			
LXXVII	AMPLOSTOMA, *Stol.*, 1868.	312						
171	—auriforme, *Stol.* ...	315	XXIII, 5	Comar. ...	Arr.			
	JANTHINIDÆ.	315						
	CALYPTRIDÆ.	315						
LXXVIII	INFUNDIBULUM, *Montf.*, 1810.	316						
172	—? sp. indet. ...	318	XIX, 25	Mor. ...	Oot.			
	CAPULIDÆ.	318						

No.	GENERA & SPECIES.	References.		Indian.		Not Indian.		REMARKS.
		Page.	Plate & Fig.	Locality.	Group.	Locality.	Group.	
	Cervicobranchiata.	320						
	TECTURIDÆ.	320						
LXXIX	TECTURA, *Aud. & Miln. Ed.*, 1830.	320						
173	— ? elevata, *Forb.* ...	322	XXVIII, 6	Pond. ...	Arr.			
174	—Footeana, *Stol.* ...	323	XIX, 27	Comar. ...	Arr.			
LXXX	HELCION, *Montf.*, 1810	321						
175	—corrugatum, *Forb.* ...	323	XXVIII, 7	Pond. ...	Arr.			
176	—carnaticum, *Stol.* ...	323	XIX, 26	Comar. ...	Arr.			
	GADINIIDÆ.	324						
	LEPETIDÆ.	325						
	SIPHONARIIDÆ.	326						
	Cyclobranchiata.	327						
	PATELLIDÆ.	328						
LXXXI	PATELLA, *Linn.*, 1752	328						
177	—sp. indet. ...	329	XIX, 23	Od. ...	Oot.			
	Scutibranchiata.	329						
	Planilabiata.	330						
	NERITIDÆ.	330						
LXXXII	NERITINA, *Lam.*, 1809	333						
178	—compacta, *Forb.*, ...	339	XXIII, 8, XXVIII, 4	Garud., Ver.	Trich.&Arr.			
179	—(Velates) decipiens, *Stol.*	340	XXIII, 9, 10	Comar. ...	Arr.			
LXXXIII	NERITA, *Adans.*, 1757	334						
180	—divaricata, *d'Orb.* ...	340	XXIII, 11, 12, XXVIII, 5	Parch. ...	Arr.			
181	—Carolina, *Stol.* ...	341	XXIII, 13, 14.	Serag. ...	Arr.			
182	—rugosissima, *Forb.* ...	342	XXV, 6	Parch. ...	Arr.			
	Ciliipedata.	342						
	UMBONIIDÆ.	344						
LXXXIV	TEINOSTOMA, *H. & A. Adams*, 1853.	346						
183	—cretaceum, *d'Orb.* ...	350	XXV, 7	Comar. ...	Arr.			

No.	GENERA & SPECIES.	References.		Indian.		Not Indian.		REMARKS.
		Page.	Plate & Fig.	Locality.	Group.	Locality.	Group.	
LXXXV	VITRINELLA, *Adams*, 1850.	347						
184	—orbiculata, *Stol.* ...	350	XXVIII,16	Verd. ...	Verd.			
	LIOTIIDÆ.	350						
	TURBINIDÆ.	352						
	PHASIANELLINÆ.	352						
LXXXVI	PHASIANELLA, *Lam.*, 1804.	352						
185	—incerta, *Forb.* ...	354	XXIII, 17-19.	Alund., Kar.	Trich. & Arr.			
186	—globoides, *Stol.* ...	354	XXIII, 16	Olap. ...	Arr.			
187	—conula, *Stol.* ...	355	XXIII, 15	Comar. ...	Arr.			
	TURBININÆ.	355						
	ASTRALIINÆ.	357						
LXXXVII	ASTRALIUM, *Link.*, 1807.	357						
188	—carnaticum, *Stol.* ...	358	XXV, 2.	Mor. ...	Oot.			
LXXXVIII	CALCAR, *Montf.*, 1810	357						
189	—jugosus, *Stol.* ...	359	XXV, 5	Mor. ...	Oot.			
LXXXIX	UVANILLA, *Gray*, 1850							
190	—Rajah, *Forb.* ...	360	XXVIII, 12.	Pond. ...	Arr.			
XC	LITHOPOMA, *Gray*, 1850.							
191	—(Cookia ?) intersecta, *Stol.*	360	XXIV,21, XXVIII,15	Comar. ...	Arr.			
	TROCHIDÆ.	361						
	GIBBULINÆ.	361						
XCI	OXYTELE, *Phil.*, 1847	360						
192	—notabilis, *Stol.* ...	369	XXIV, 2	Comar. ...	Arr.			
XCII	GIBBULA, *Leach*, 1826	368						
193	—Jerdoniana, *Stol.* ...	370	XXIV, 6, 7	Comar. ...	Arr.			
194	—granulosa, *Stol.* ...	370	XXIV, 8, 9, XXVIII, 14.	Vyl., Comar., &c.	Arr.			

No.	GENERA & SPECIES.	References.		Indian.		Not Indian.		REMARKS.
		Page.	Plate & Fig.	Locality.	Group.	Locality.	Group.	
XCIII	EUCHELUS, *Phil.*,1847	363						
195	—ornatus, *Stol.* ...	371	XXIV, 10	Veragh., &c.	Arr.			
	TROCHINÆ.	364						
XCIV	TECTUS, *Montf.*, 1810	365						
196	—Tamulicus, *Stol.* ...	371	XXIV, 4, 5	Comar., &c.	Arr.			
197	—junceus, *Stol.* ...	372	XXIV, 3	Comar. ...	Arr.			
XCV	ZIZIPHINUS, *Gray*, 1840.	365						
*198	—(Eutrochus ?) Geinitzianus, *Rss.*	373	XXIV, 11-15.	Garud., And., Veragh., Comar., &c.	Trich.&Arr.	Saxony, Belgium, Bohemia, &c.	Hippuritic limestone.	Turonien.
XCVI	CANTHARIDUS, *Montf.*, 1810.	367						
199	—striolatus, *Stol.* ...	374	XXIV, 1	Comar. ...	Arr.			
	MARGARITINÆ.	367						
XCVII	SOLARIELLA, *Wood*, 1842.	367						
*200	—radiatula, *Forb.* ...	375	XXIV, 17-19; XXVIII, 8, 9.	Mor., Od., Kol., Vyl., Comar., &c.	Oot., Trich., & Arr.	Aachen ...	Sen, ...	Probably also occurring at Tournay, Sth. France, & in Saxony.
201	—strangulata, *Stol.* ...	376	XXIV, 20, XXVIII, 10.	Od, ...	Oot.			
XCVIII	MARGARITA, *Leach*, 1819.	368						
202	—orbiculata, *Stol.* ...	377	XXIV, 16	And., Garud.	Trich.			
	DELPHINULINÆ.	368						
XCIX	DELPHINULA, *Lam.*, 1803.	368						
203	—annularis, *Stol.* ...	377	XXV, 3	Od. ...	Oot.			
204	—? rotelloides, *Forb.* ...	378	XXVIII, 73.	Pond. ...	Arr. (?).			
	STOMATIIDÆ.	378						
	Fissobranchiata.	379						
	Schismatobranchiata.	380						
	PLEUROTOMARIIDÆ.	380						

No.	GENERA & SPECIES.	References.		Indian.		Not Indian.		REMARKS.
		Page.	Plate & Fig.	Locality.	Group.	Locality.	Group.	
C	PLEUROTOMARIA, *Defr.*, 1821.	381						
205	—loricatula, *Stol.* ...	385	XXV, 4	Od. ...	Oot.			
206	—glabella, *Stol.* ...	386	XXV, 8, 9	Puravoy...	Oot.			
CI	LEPTOMARIA, *Desl.*, 1865.	382						
207	—indica, Forb. ...	386	XXVI, 1-4	Od., Mor., Olap., Comar., &c.	Oot. & Arr. (Trich.?).	...	...	Very similar to many species from the upper cretaceous beds of Germany and France.
	HALIOTIDÆ.	387						
	Dicranobranchiata.	390						
	FISSURELLIDÆ.	390						
CII	EMARGINULA, *Lam.*, 1801.	391						
208	—sp. (conf. E. Guerangeri, *d'Orb.*)	394	XXVIII, 8	Od. ...	Oot.			
	OPISTHOBRANCHIA.	394						
	Pleurobranchiata.	396						
	Monopleurobranchiata.	396						
	ACTÆONIDÆ.	398						
	ACTÆONINÆ.	398						
CIII	ACTÆONINA, *d'Orb.*, 1850.	399						
209	—obesa, *Stol.* ...	412	XXVIII, 31	Comar. ...	Arr.			
210	—columnaris, *Stol.* ...	413	XXVIII, 26	Pond. ...	Val.			
CIV	BULLINA, *Fer.*, 1821	401						
211	—alternata, *d'Orb.* ...	401	XXVII, 17, 18.	Garud. & Ver.	Trich.			
212	—cretacea, *d'Orb.* ...	414	XXVII, 19	Garud. ...	Trich.			
CV	ACTÆON, *Montf.*, 1810	402						
213	—(Solidula) semen, *Forb.*	415	XXVII, 5, 6, 7.	Garud., Ninn.	Trich., Arr.			
214	—(„) pugilis, *Stol.*	415	XXVII, 8, 9	Comar. ...	Arr.			

No.	GENERA & SPECIES.	References.		Indian.		Not Indian.		REMARKS.
		Page.	Plate & Fig.	Locality.	Group.	Locality.	Group.	
CV	ACTÆON,—*contd.*							
215	—seminalis, *Stol.* ...	416	XXVII, 16 XXVIII,18	Garud. ...	Trich.			
216	—turriculatus, *Stol.* ...	416	XXVII, 10, 11, XXVIII,19	Garud. ...	Trich.			
217	—curculio, *Forb.* ...	417	XXVII,12, 13.	Comar. ...	Arr.			
218	—junceus, *Stol.* ...	417	XXVII, 15	Od. ...	Oot.			
CVI	TROCHACTÆON, *Meek*, 1863.	403						
219	—truncatus, *Stol.* ... (*Actæonella id).*	418	XIV, 8	Shill. ...	Arr.			
220	—minutus, *Stol.* ...	418	XIV, 9, XXVIII,17	Comar. ...	Arr.			
221	—cylindraceus, *Stol.* ... (*Actæonella id).*	419	XIV, 10-14 (not 9).	Kolak., Kolot., Serd., Parch., And., &c.	Oot. & Trich.			
	APLUSTRINÆ.	403						
CVII	BULLINULA, *Beck.*, 1840.	404						
222	—obtusiuscula, *Stol.* ...	420	XXVII, 14 XXVIII, 25.	Arr. ...	Arr.			
	RINGICULINÆ.	405						
CVIII	AVELLANA, *d'Orb.*, 1842.	406						
223	—ampla, *Stol.* ...	420	XXVI, 8, XXVIII, 20.	N. W. of Veragh.	Trich.			
224	—scrobiculata, *Stol.* ...	421	XXVI, 9, XXVIII, 21.	Comar., Vyl., &c.	Arr.			
225	—sculptilis, *Stol.* ...	422	XXVII, 1, XXVIII,22	Kar., Arr.	Arr.			
*226	—elongata, *Guér.* ...	422	XXVII, 2, XXVIII, 23, 24.	Od., Shut.	Oot. ...	Le Mans.	Cenoman; with *Ostr. biauriculata.*	
CIX	RINGINELLA, *d'Orb.*, 1840.	406						
227	—acuminata, *Stol.* ...	423	XXVII, 4	Comar. ...	Arr.			
CX	RINGICULA, *Desh.*, 1838.	406						
228	—acuta, *Forb.* ...	424	XXVII, 3	Garud. ...	Trich.			
229	—labiosa, *Forb.* ...	424	XXVIII,28	N. of Kar.	Arr.			

No.	GENERA & SPECIES.	References.		Indian.		Not Indian.		REMARKS.
		Page.	Plate & Fig.	Locality.	Group.	Locality.	Group.	
CXI	EUPTYCHA, *Meek.*, 1863.	406						
230	—globata, *Stol.* ...	425	XXVI, 5	Olap. ...	Trich. (? Arr.)			
231	—larvata, *Stol.* ...	426	XXVI, 6	Comar. ...	Arr.			
232	—oviformis, *Forb.* ...	426	XXVI, 7	Serd.,Kolot.	Trich.			
	BULLIDÆ.	427						
	CYLICHNINÆ.	427						
CXII	CYLICHNA, *Lovèn*, 1846.	428						
233	—inermis, *Stol.* ...	431	XXVII,20	Comar. ...	Arr.			
	BULLINÆ.	429						
	OXYNOEIDÆ.	431						
	PHILINEIDÆ.	433						
	APLYSIIDÆ.	397						
	PLEUROBRANCHIDÆ.	397						
	RUNCINIDÆ.	397						
	PROSOPOCEPHALA.	435						
	Scaphopoda.	437						
	DENTALIIDÆ.	437						
	ANTALINÆ.	437						
CXIII	DENTALIUM, *Aldr.*, 1642.	437						
234	—crassulum, *Stol.* ...	444	XXVII,21	Serd. ...	Trich.			
CXIV	ANTALE, *Aldr.*, 1642	438						
235	—Arcotinum, *Forb.* ...	444	XXVII,23	Pond. ...	Val.			
236	—glabratum, *Stol.* ...	444	XXVII,25	Od. ...	Oot.			
CXV	FUSTIARIA, *Stol.*, 1868.	439						
237	—parvula, *Stol.* ...	444	XXVII,22	Pond. ...	Val.			

General remarks on the character of the GASTROPODOUS FAUNA of the CRETACEOUS ROCKS OF SOUTH INDIA.

It will be impossible to pronounce a definite opinion as to the character of the fauna of our South Indian cretaceous deposits and of their representatives in European beds until all the groups or sub-classes of Mollusca, etc., have been examined; but the separate results, as obtained from the detailed study of each of the divisions, are not wholly devoid of interest, inasmuch as they exhibit a special value in their bearing upon the general conclusions; they are, therefore, in cases where relative comparisons can be instituted, of the greatest importance. I shall consequently give here* a short review of the principal facts resulting from the study of the Gastropoda, as I have previously done in a similar manner with the Cephalopoda.

The principle of classification which has been adopted is sufficiently exhibited in the list of the described species (see Appendix B, pp. 461-479). With regard to the higher divisions I have accepted a great deal from Bronn's "Klassen und Ordnungen des Thierreiches, vol. III," but with regard to the subordinate divisions I have mostly followed H. and A. Adams' "Genera of recent Mollusca." In neither case have I done it, however, slavishly, and when alterations in the arrangement of the families and genera, or in their names, suggested themselves, I have been anxious to introduce improvements. The chief object was to obtain as far as possible a correct generic determination of our cretaceous fossils, and then to show the representation of the cretaceous Gastropoda among the whole Gastropodous fauna, as known, fossil and recent. At the same time I have been desirous to prove of what very great importance the study of fossil Gastropoda is with a view to classification; having repeatedly had occasion to state that without the knowledge of the fossil forms no natural grouping of shells can ever be obtained. Sufficient zoological information was somewhat slowly procured, but this was chiefly due to the little attention that many palæontologists have paid, and still do pay, to fossils as *zoological* objects, considering that the inquiries about them ought to terminate with the discussion of their *geological* value. These obstacles, however, have now happily abated and will undoubtedly soon disappear. Geological research requires the determination of fossils, and Palæontology asks for an explanation of the time and of the conditions under which these fossils lived, in connection with the state of things prior and posterior to that geological formation. All other information with regard to fossils can only be obtained from *zoological* sources.

The Gastropodous fauna of the cretaceous deposits of South India is remarkably rich, though, relatively, not so large as might have been expected from the report on the Cephalopoda.

The total number of species as known at the present is 237; these have been referred to 115 genera; these again classified in 41 families and a number of sub-families.

* See also "Records Geol. Surv., India," Pt. III, 1868, p. 55.

Looking upon the higher divisions of the Gastropoda, as noticed in our introductory remarks, it will be seen that of the eight orders four* are represented in our South Indian cretaceous deposits, namely, the PULMONATA, PROSOBRANCHIA, OPISTHOBRANCHIA and PROSOPOCEPHALA. Of these the PROSOBRANCHIA, as might be expected, are the most numerous.

The occurrence of four species of *HELICIDÆ* in the highest, the Arrialoor beds, is of particular interest. Three of the species belong to the group *Angystoma* and one to *Macrocyclis;* they all approach to Indian types of *HELICIDÆ*, and one of them, *Angystoma Arrialoorense*, is very closely allied to the recent *Helix Nilgirica*. The identity of fossil with recent species is always a difficult point to be settled and often leads to disputes among naturalists, but it is a well known fact that the physical changes which have at different times taken place have often greatly affected the marine faunas, while the land fauna remained unaltered. I will not with our present meagre materials advocate the idea, that cretaceous species of land shells are still found living, but considering the absence of any largely developed tertiary deposits in the same districts, where the cretaceous beds of Trichinopoly occur, there would be nothing very novel in that suggestion.

The PROSOBRANCHIA display a very great variety of forms. There are very few of their established families which have no representatives; and some of them like the *CYPRÆIDÆ*, *VOLUTIDÆ*, *PURPURIDÆ*, *CERITHIIDÆ* and *NATICIDÆ* are particularly numerous. The *CYPRÆINÆ* deserve special attention, because most of the species have, up to recent date, been referred to the *OVULINÆ*, of which, however, there seems to be not a single cretaceous species as yet recognised with sufficient accuracy. Equally interesting is the occurrence of members of the family *TRICHOTROPIDÆ* and *CANCELLARIIDÆ;* the *LITTORINIDÆ* have also been found largely represented, and the genus *Littorina* and others were unjustly excluded by d'Orbigny from the cretaceous deposits, as they are already in the older secondary formations, and even in the palæozoic period, numerous, and most probably more varied in form than we meet with them in the cretaceous and tertiary beds.

Some genera like *Erato, Dipsacus, Oniscia, Cythara, Trophon, Euclia* and *Narona, Teinostoma, Vitrinella* and others have now been first noticed as occurring in cretaceous deposits; others, like *Cypræa* (and allied forms) *Rapa, Rissoa, Rissoina, Littorina, Velutina* and others have been fully established in their geological importance with regard to the same period.

Of the OPISTHOBRANCHIA the family *ACTÆONIDÆ* is comparatively very largely represented, there being no less than 24 species known from the cretaceous deposits of South India. Among these two species of *Actæonina*, one of *Bullinula*, two of *Ringicula* and three of *Euptycha* deserve a special notice.

The PROSOPOCEPHALA with their family *DENTALIIDÆ* have been treated at considerable length, but they exhibit no particular forms; only four species occur, belonging to the genera *Dentalium, Antale* and *Fustiaria* (n. gen.).

* The other four being the NEUROBRANCHIA, HETEROPODA, POLYPLACOPHORA and PTEROPODA.

The geological groups of the South Indian cretaceous deposits have been again quoted according to Mr. H. F. Blanford's report on these rocks in the IVth volume of the Memoirs of the Geological Survey; they are, beginning with the lowest, the *Ootatoor-*, *Trichinopoly-* and *Arrialoor*-groups, and in addition to these the *Valudayur* group near Pondicherry, in the main features corresponding with the lowest group, though the *Arrialoor* beds (*Verdachellum*-group) by far predominate at this place, and most of the fossils first obtained by Messrs. Kaye and Cunliffe appear to have belonged to them.

All these groups have not yielded an equal number of Gastropoda. When speaking of the Cephalopoda I remarked that the largest number had been derived from the Ootatoor beds; this is, however, not the fact in the present case; the number of Gastropoda obtained from the lowest beds is the smallest and these all appear to be littoral forms. This is a very interesting fact, but it would be in vain to attempt an explanation of it, until, after examination of the entire fauna, the ground shall have been re-examined and the distribution of molluscs in the different beds compared with the same distribution in the present adjoining seas.

The majority of the Gastropoda (113 sp.) belong to the Arrialoor beds, being deposits in shallow water: next comes the Trichinopoly group with 59, and at last the Ootatoor with 36 species; these are peculiar to each group, but a number of other species are common to the first and second, or the second and the third.

There are only 30 species, or very nearly one-eighth of the total (237) number, identical with species from cretaceous rocks of Europe and elsewhere; these identical species, however, very nearly all belong to the upper beds of cretaceous deposits, including the beds from the Cenomanien upwards. Glancing at the entire Gastropodous fauna of the South Indian cretaceous deposits its *cretaceous* character could not be mistaken for a moment. This is specially prominent in the peculiar forms of the *Alata*, the *Cerithiidæ*, *Rissoidæ*, *Naticidæ*, the large number of *volutinæ* (of the *Volutidæ*), the absence of *Turbinidæ*, excepting those belonging to the sub-family *astraliinæ*, the distinct types of the *Pleurotomariidæ* and *Pyramidellidæ*, etc. The absence of the usual large number of *Conidæ*, *Pleurotomidæ*, *Terebridæ*, the *nassinæ* of the *Buccinidæ*, the *mitrinæ* of the *Volutidæ*, and others commonly occurring in tertiary beds is very noticeable. At the same time it cannot be questioned that there is some approach of our fauna to the tertiary one, inasmuch as several types of shells occur which have previously not been noticed below the eocene beds, like *Cythara*, *Oniscia*, *Trophon*, *Pseudoliva*, *Euclia*, *Narona* and others. I entirely reject, however, the argument of some palæontologists, that certain genera are restricted to certain formations. It is clear enough that a certain type of Gastropod, which we call a genus, must have made its first appearance somewhere, but this is a point which experience must settle, or regarding which no statement could have any value, excepting so far as it were justified by our experience limited to a certain date. But to determine *a priori* that a genus does not occur below the tertiary formation, and to start with the idea that rocks must be *kainozoic* because they contain a

few fossil types not as yet met with below these strata, is simply to impede the progress of science. Field geology has yet a great task to solve.

The character of the South Indian cretaceous fauna of the Gastropoda is not only decidedly cretaceous, but it is decidedly *upper cretaceous*. All the 30 species which have been identified with European ones occur in upper cretaceous strata, hardly any (at least not with undoubted certainty) below the Cenomanien, while the largest number is found in the Turonien and Senonien beds. Besides I may mention that many of the species, at present not identified, have a very great resemblance to others from the two last named series of beds, and more identifications may still in time be established.

Thus the conclusion formed from the examination of the Gastropoda alone would place the lowest beds of our South Indian cretaceous deposits higher than that formed from the examination of the Cephalopoda. I formerly stated that the South Indian cretaceous beds represented the deposits from the Gault to the Senonien. The Gastropoda have, it may be said, not yielded a single species identical with a typical one from the Gault,* and as most of the species of Cephalopoda which I have previously quoted as occurring in the Gault have been shown to pass higher into the Cenomanien beds, the present conclusions regarding the age of the South Indian cretaceous beds appear to be nearer the truth. I need hardly, however, repeat that they must not be considered final, being based merely upon a partial examination of the fauna.

The uppermost of our deposits, the Arrialoor group, have a great relation to the Senonien beds of Aachen and North Germany. When lately at Paris I also noticed in a collection, which Prof. Hebert made from the "craie pisolitique" near that capital, two of our common species of *Cerithium*, *C. Arcotense* and *inauguratum* (see pp. 193 and 197).

* *Scala? Clementina* is doubtfully identical; *Cerithium trimonile* and *Alaria Parkinsoni* and a few others occur in the Gault and in the Cenomanien.

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N. B.—The Indian species described in the preceding pages are marked with an asterisk.

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ERRATA

Some of the most important corrections have been already noticed in Appendix A, pp. 446-460.

(in the letter-press).

Page 34, line 8, from bottom, for whorl read whorls.
„ 35, lines 2, 4 and 12, from bottom, for *Scarabæus* read *Scarabus*.
„ 43, line 12, from bottom, for Figs. 1-3 read Figs. 1 and 3.
„ 179, „ 8, „ „ „ *Criptoplocus* read *Cryptoplocus*.
„ 191, „ 20, „ „ „ b. *Sub-family* read c. *Sub-family*.
„ 216, „ 7, from top, for *tuberculatu* read *tuberculata*.
„ 216, „ 7, „ „ „ *undulata* „ *undulate*.
„ 217, „ 11, „ „ „ *ornatis* „ *ornata*.
„ 224, „ 30, „ „ „ d'Orbignyi „ d'Orbigny.
„ 226, „ 4, „ „ „ *qnadriciucta* „ *quadricincta*.
„ 229, „ 31, „ „ „ *Amcæa* „ *Acmæa*.
„ 232, „ 6, „ „ „ *in un* „ *in uno*.
„ 236, „ 20, „ „ „ PTEOTOPODA „ PEOTOPODA.
„ 237, „ 13, „ „ „ *sæpissiime* „ *sæpissime*.
„ 243, „ 29, „ „ „ remnents „ remnants.
„ 246, „ 2, „ „ „ Fisher „ Fischer.
„ 249, „ 15, „ „ „ pucispiral „ paucispiral.
„ 249, „ 1, from bottom, for practicla „ practical.
„ 250, „ 28, from top, for *flexui-striatum* read *flexi-striatum*.
„ 259, „ 22, „ „ (and passim) for *LITORINIDÆ* read *LITTORINIDÆ*.
„ 260, „ 4, „ „ for pucispiral read paucispiral.
„ 356, „ 10, „ „ „ *armaticus* read *Sarmaticus*.
„ 358, „ 17, „ „ „ *tomatia* read *Stomatia*.
„ 365, „ 13, „ „ „ *Caliostoma* read *Calliostoma*.
„ 372, „ 1, from bottom, for as read than.
„ 387, „ 21, from top, for appears read appear.
„ 403, „ 3, from bottom, for *Etalonia* read *Etallonia*.
„ 405, „ 13, „ „ „ priority read propriety.
„ 431, „ 14, from top, for latter read later.
„ 432, lines 24 and 29, from top, for *convolute* read *involute*.
„ 453, line 1, from top, for *Pric.* read Prisc.
„ 459, „ 22, „ „ „ Scalænostoma read Scalenostoma.
„ 459, „ 24, „ „ „ here read there.
„ 460, „ 3, from bottom, for Scalænostoma read Scalenostoma.

(in the explanations of the Plates).

Plate I, for ANCHISTOMA read *passim* ANGYSTOMA.
„ IV, Fig. 1, for OVULA ANTIQUATA, *d'Orb.*, read CYPRÆA CUNLIFFEI, *Forbes*, ; see p. 450.
„ IV, Fig. 4, for CYPRÆA CUNLIFFEI, Forb., read CYPRÆA CARNATICA, Stol. ; see p. 450.
„ V, in Figs. 1, 2, 3, 4, 5, for the generic name PTERODONTA read TYLOSTOMA ; see pp. 292 and 448.
„ IX, Fig. 1, for VOLUTILITHES LATISEPTA, *Stol.*, read VOLUTILITHES SEPTEMCOSTATA, *Forb.*; see p. 454.
„ X, Figs. 17, 18, for HEMIFUSUS CINCTUS, *Stol.*, read HEMIFUSUS CINCTUS, *Forb.*; see p. 456.
„ XIV, Fig. 8, for ACTÆONELLA TRUNCATA read TROCHACTÆON TRUNCATUS ; see p. 418.
„ XIV, Fig. 9, represents TROCHACTÆON MINUTUS, *Stol.*, Comarapolliam ; Arrialoor group ; see p. 418.
„ XIV, Figs. 10-14, for ACTÆONELLA CYLINDRACEA read TROCHACTÆON CYLINDRACEUS ; see p. 419.
„ XVI, Fig. 5, for CERITHIUM ANTECEDENS, *Stol.*, read CERITHIUM TRICHINOPOLITENSE, Forb. ; see p. 460.

PLATE I.

Figs. 1—5. ANCHISTOMA CRETACEUM, *Stol.*; p. 9; 1, front view of a small specimen showing the teeth of the inner lip; 2, basal view of the interior whorls of a larger specimen, to exhibit the sharp edge round the umbilicus in the young shell; 3, and 3 *a*, upper-and front-views of a nearly complete specimen, and 3 *b*, the exterior termination of the last whorl to show the dentition of the outer lip; 4, front-and basal-views of a much depressed specimen; 5, front-and upper-views of a complete specimen; 5 *a*, showing the lateral depression of the last whorl near the aperture. All the figures are enlarged twice, and the natural size is given in the accompanying cross-lines representing the diameter and the height; all specimens are from near *Comarapolliam* (N. of Arrialoor), in the *Arrialoor group*.

Fig. ... 6. ANCHISTOMA ARRIALOORENSE, *Stol.*; p. 10; upper-front-and basal-views of a specimen of twice the natural measurements, the shell surface is partly not preserved, and the probable shape of the aperture is restored in outline; from *Ninnyoor*, in the *Arrialoor group*.

Fig. ... 7. ANCHISTOMA ARCOTENSE, *Stol.*; p. 11; 7, 7*a*, 7*b*, upper, basal-and front-views; 7*c*, lateral view of the last whorl (with the shell taken off) to show the form of the single tooth on the outer lip; the figures are enlarged to twice the actual measurements, which are given by cross-lines; from *Alundanapooram*, *Trichinopoly group*.

Fig. ... 8. MACROCYCLIS CARNATICA, *Stol.*; p. 12; 8 and 8*a*, upper-and front-views of a somewhat mutilated specimen; 8*b*, is a restored outline of the probable shape of the specimen, and the difference in the thickness of these two is given in the accompanying cross-lines; the specimen is figured of the natural size; from near *Veraghoor*, in the *Arrialoor group*.

1.
2.
3
3 a
3 b
4.
4. a.
5.
5 a.
6
6 b.
6 a.
7.
7. a.
8.
8. a
7 b
7 c
8. b.

PLATE II.

Fig. ... 1. APORRHAIS ARRIALOORENSIS, *Stol.*; p. 28; 1 and 1 *a*, front-and back-views, enlarged to twice the linear dimensions; the wanting parts of the wing have been restored in outline; *Comarapolliam; Arrialoor group.*

Figs. 2—4. APORRHAIS SECURIFERA, *Forbes*, sp.; p. 28; 2—2*a*, front and back-views of a nearly complete specimen; 4, front-view of a large fragment, with much thickened internal margins of the aperture; both specimens from near *Alundanapooram;* 3, an imperfect specimen with somewhat more convex whorls and a fine spiral striation; from *Kolakonuttom; Trichinopoly group.*

Figs. 5—8. ALARIA PARKINSONI, *Mant.* sp.; p. 30; 5, front-view of a cast with the impression of the wing; 6, back-view of another specimen, with the posterior outline of the wing; both from near *Odium; Ootatoor group;* 7, small specimen with smooth embryonal whorls from *N. of Serdamungalum*, and 8, front-view of an incomplete specimen from *S. of Serdamungalum; Trichinopoly group.*

Figs. 9—10. ALARIA PAPILIONACEA, *Goldf.* sp.; p. 31; 9, back-view of a specimen from *N. of Serdamungalum*, and 10, front-view of a specimen from near *Coonum; Trichinopoly group.*

Figs. 11—13. ALARIA TEGULATA, *Stol.*; p. 33; 11—11*a*, front and back-views of an incomplete specimen with numerous thin ribs; from *Olapaudy; Arrialoor group;* 12, front-view of a specimen with somewhat larger spiral angle, wing and anterior canal broken away; 13, back-view of another incomplete specimen with moderately distant and continuous ribs; the last two from near *Kolakonuttom; Trichinopoly group.*

Figs. 14—15. ALARIA GLANDINA, *Stol.*; p. 32; 14—14*a*, front and back-views of a nearly complete specimen, and 15, front-view of a larger, but incomplete specimen; both from near *Anapaudy; Trichinopoly group.*

Figs. 16—17. ALARIA ACICULARIS, *Stol.*; p. 32; 16—16*a*, front and back-views, and 17, back-view of incomplete specimens; both from *Olapaudy; Arrialoor group.*

Figs. 18—20. ROSTELLARIA PALLIATA, *Forbes*, p. 34; 18—18*a*, front and back-views of a cast specimen from *S.* of *Serdamungalum; Trichinopoly group;* 19,* an imperfect specimen from near *Pondicherry (?) Valudayur group*; 20—20*a*, back and front-views of a specimen from *Olapaudy; Arrialoor group;* the probable shape of the outer lips has been completed in outline, which ought to indicate anteriorly a more distinct notch.

* This specimen is in the Madras Collection.

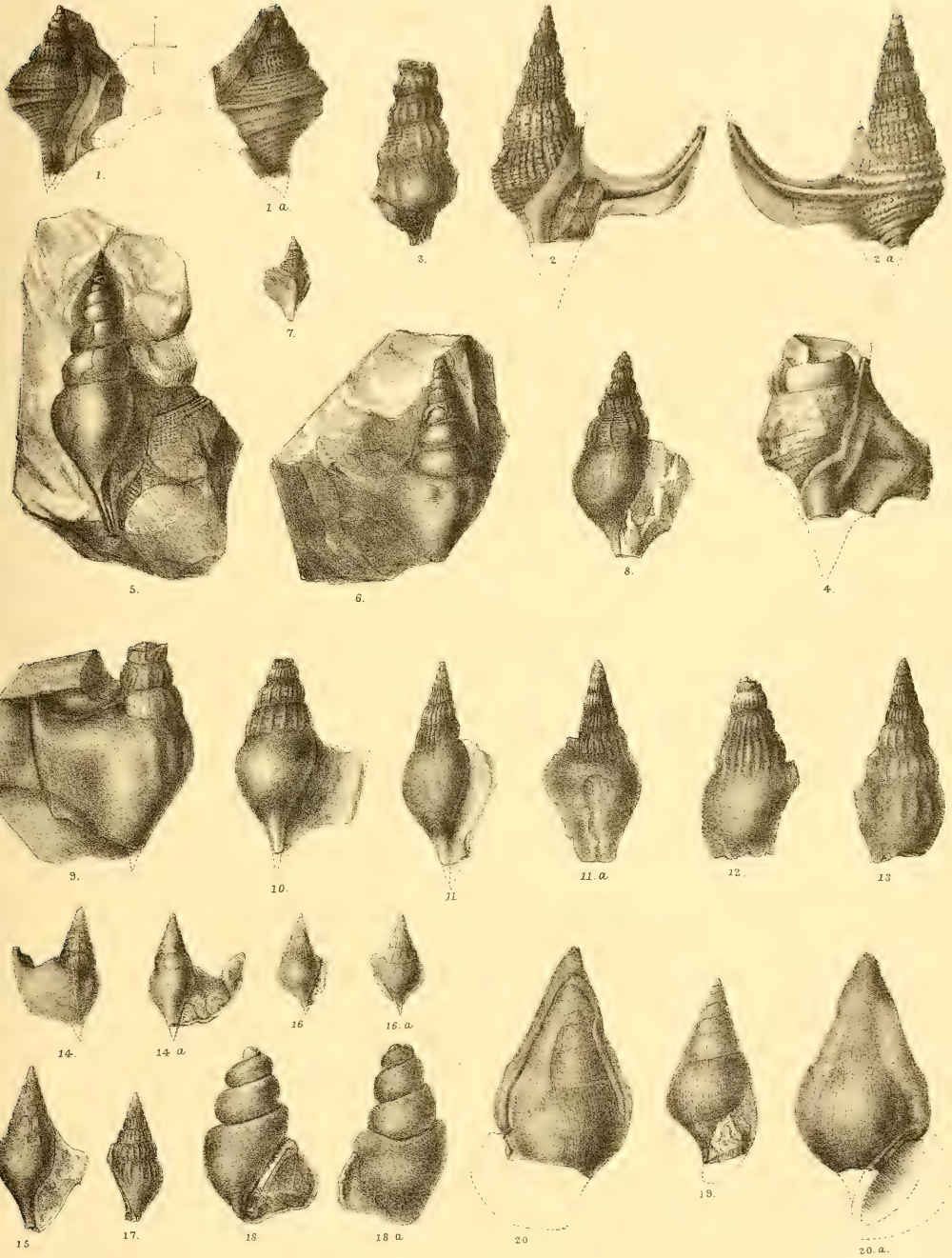
1.
1 a.
3.
2
2 a.
7.
5.
6.
8.
4.
9.
10.
11
11. a
12.
13
14.
14 a
16
16. a
15
17.
18
18 a
20
19.
20. a.

PLATE III.

Figs. 1—5. PUGNELLUS CONTORTUS, *Sow.*, sp.; p. 19; 1—1*d*, different views of a complete specimen; 2, front-view of an imperfect specimen; 3, ditto of a cast; 4, back-view of a cast-specimen with the greater portion of the last whorl, but without the margins of the aperture; 5—5*a*, front-and back-views of an incomplete specimen, with numerous and thin transverse ribs; all specimens from *N. of Alundanapooram; Trichinopoly group.*

Figs. 6—8. PUGNELLUS GRANULIFERUS, *Stol.*; p. 21; 6-6*a*, front-and back-views of an incomplete specimen from *S.* of *Serdamungalum*; 7, back-view of a nearly complete cast from *Anapaudy*; both these localities are in the *Trichinopoly group*; 8, different views of a large specimen from *W.* of *Illpagoody*; the anterior termination of the canal has been restored in outline; *Arrialoor group.*

Figs. 9—13. PUGNELLUS UNCATUS, *Forbes*; p. 22; 9—9*d*, different views of a nearly full grown, complete specimen; 10, front-view of an incomplete, but larger specimen with enveloped spire; 12 and 13, front and back-views of cast-specimens; all these are from near *Arrialoor* in the *Arrialoor group*; 11 is a front-view of an incomplete specimen from near *Pondicherry* in the *Trichinopoly group.*

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1.a.

1.b

1.c

1.d.

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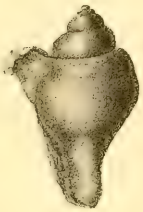
6.a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8.a.

8 b.

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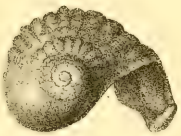
8 d.

9.

9 a.

9 b.

9 c.

9 d.

10

11.

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13.

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PLATE IV.

Fig. ... 1. Ovula antiquata, *D'Orb.*; p. 47; 1, front-, 1 *a*, back-, 1 *b*, posterior-views; from *Arrialoor*; *Arrialoor group*.

Figs. 2—3. Cypræa (Luponia) Newboldi, *Forb.*; p. 54; 2, back-, 2*a*, front-, 2*b*, posterior-views of a well preserved specimen from near *Andoor*; 3, front-view of a cast from *W. of Kullygoody*; all from a light coloured gritty sandstone of the *Trichinopoly group*, but close to the boundary of the *Arrialoor group*.

Fig. ... 4. Cypræa (Luponia) Cunliffei, *Forb.*; p. 55; 4, front-, 4*b*, posterior-, 4*a*, back-views of a specimen, partly completed from another; near *Veraghoor* in the *Arrialoor group*.

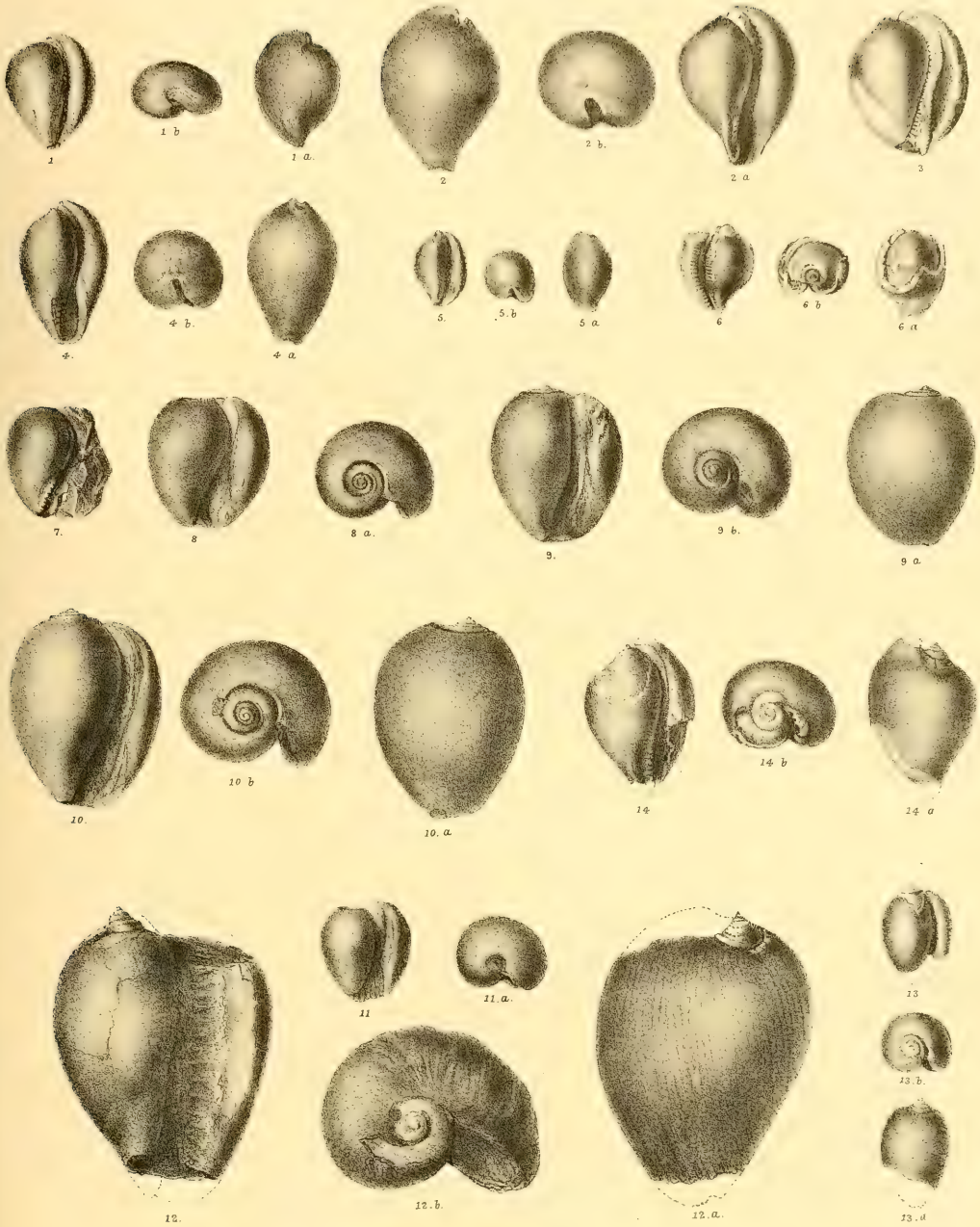
Fig. ... 5. Cypræa (Luponia) pilulosa, *Stol.*; p. 53; 5, front-, 5 *b*, posterior-, 5 *a*, back-views of a specimen from near *Moraviatoor* in the *Ootatoor group*.

Fig. ... 6. Cypræa (? Epona) anomala, *Stol.*; p. 56; 6, front-, 6 *b*, posterior-, 6 *a*, back-views of a specimen, which on the posterior portion is devoid of shell; from near *Vylapaudy*; *Arrialoor group*.

Figs. 7—10. Cypræa Kayei, *Forbes*; p. 56; 7, front-view of a specimen from near *Andoor*; *Trichinopoly group*; it has the callose inner lip partly preserved, and shows the dentition; 8 and 10 are specimens from the *S. of Serdamungalum (Trich. group)*; they are casts without a trace of shell; 9 is a representation of a specimen from near *Arrialoor (Arr. group)*; it is equally a cast, but traces of dentition are perceptible on the inner marginal impression of the outer lip.

Figs. 11—12. Cypræa (Aricia) ficulina, *Stol.*; p. 53; 11, front-and posterior-views of a young specimen from the sandstones *W. of Kullygoody (Trich. group)*; 12, front-, posterior-, and back-views of a larger specimen from *Alundanapooram (Trich. group)*; the probable shape of the specimen has been restored in outline.

Figs. 13—14. Erato Veraghoorensis, *Stol.*; p. 59; 13—13 *b*, front-, posterior-, and back-views of a young specimen, and 14-14 *b*, the corresponding views of an apparently full grown specimen; the wanting portions have been restored in outline to their probable shape; both specimens from the *Arrialoor* beds near *Veraghoor*, occurring in light coloured sandstones.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12.b.
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13.b.
13.d

PLATE V.

Figs. 1 and 3.* PTERODONTA OOTATOORENSIS, *Stol.;* p. 43; 1-1*a*, front-and back-views of a large specimen, the front side being devoid of the shell surface, and showing a few marginal impressions on the upper whorls; 3, front-and top-views of a cast-, the section of the aperture is taken through the internal thickening of the outer lip; both from near *Odium; Ootatoor group.*

Figs. 2 and 4. PTERODONTA NOBILIS, *Stol.;* p. 43; 2-2*a*, front-and back-views; in the former the shell is perfect on the last whorl; 4 is a cast showing the disposition of the impressions; both from *Garudamungalum; Trichinopoly group.*

Fig. ... 5. PTERODONTA BULIMOIDES, *Stol.;* p. 42; front-and back-views of a young, but apparently complete specimen; the shell surface is preserved, except in 5 *b*, on a portion of the last whorl; *Veraghoor; Arrialoor group.*

Figs. 6—8. PTERODONTA? TEREBRALIS, *Stol.;* p. 42; 6, front-view of an imperfect specimen, on which the smooth shell surface is partially preserved; 7 and 8, front-views of casts; the former showing the two columellar plaits distinctly, and the latter the lengths of the canal; near *Odium; Ootatoor group.*

Fig. ... 9. ONISCIA COSTELLATA, *Stol.;* p. 63; front-, side-,and back-views of a nearly complete specimen from the sandstones *S. of Arrialoor; Arrialoor group.*

Fig. ... 10. CYTHARA CRETACEA, *Stol.;* p. 66; front,-side,-back,-and top-views of a specimen, on the last whorl of which the shell is mostly well preserved; *Veraghoor; Arrialoor group.*

* p. 43, line 12 from below, *read* Figs. 1 and 3, *instead of*, Figs. 1—3.

1.

1. a.

3. a

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2.

2. a.

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5 a

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5. b.

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9 a.

9 b.

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10 a.

10 b.

10 c

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PLATE VI.

Figs. 1—2. PLEUROTOMA SUBFUSIFORMIS, *D'Orb.*; p. 69; 1, front-view of a specimen with perfect anterior canal, the outer lip restored in outline; 2, side-view of another specimen, showing the insinuation and the posterior portion of the outer lip perfect; both from near *Andoor; Trichinopoly group.*

Figs. 3, 7, 8. GOSAVIA INDICA, *Stol.*; p. 73; 3-3*a*, front-and side-views of a nearly perfect, small specimen; 7, front-view of a large specimen showing the disposition of the folds on the inner lip; the probable shape is marked in outline; both specimens are from a whitish sandstone *between Andoor and Veraghoor;* 8, back-view of a specimen from a similar sandstone *W. of Kullygoody;* the shell surface is only partially preserved, but exhibits clearly the spiral striation, specially on the keel; *Trichinopoly-*, if not *Arrialoor- group.*

Figs. 4—5. SCAPHA ATTENUATA, *Stol.*; p. 82; 4, front-view of a specimen nearly complete, as regards form, but the shell surface is a little worn off; 5, back-view of another specimen, on which the surface is better preserved; *Kolakonuttom; Trichinopoly-group.*

Fig. ... 6. SCAPHA GRAVIDA, *Stol.*; p. 82; front-view of a specimen from *Ninnyoor;* the outer lip and anterior termination have been restored in outline; *Arrialoor group.*

Fig. ... 9. MELO PYRIFORMIS, *Forbes*, sp.; p. 83; 9-9*a*, front-and back-views of a nearly complete specimen; only a small portion of the shell near the anterior termination having been restored from another; from a softish light coloured sandstone near *Pondicherry?; Valudayur-*, or more probably *Arrialoor group.*

Figs. 10—11. FICULOPSIS PONDICHERRIENSIS, *Forbes*, sp.; p. 85; 10, front-view of an imperfect specimen, mostly a cast, but showing the disposition of the plaits on the inner lip; from *Kullygoody; Trichinopoly group;* 11-11*a*, front and back-views of a nearly complete specimen; *Pondicherry; Valudayur group.*

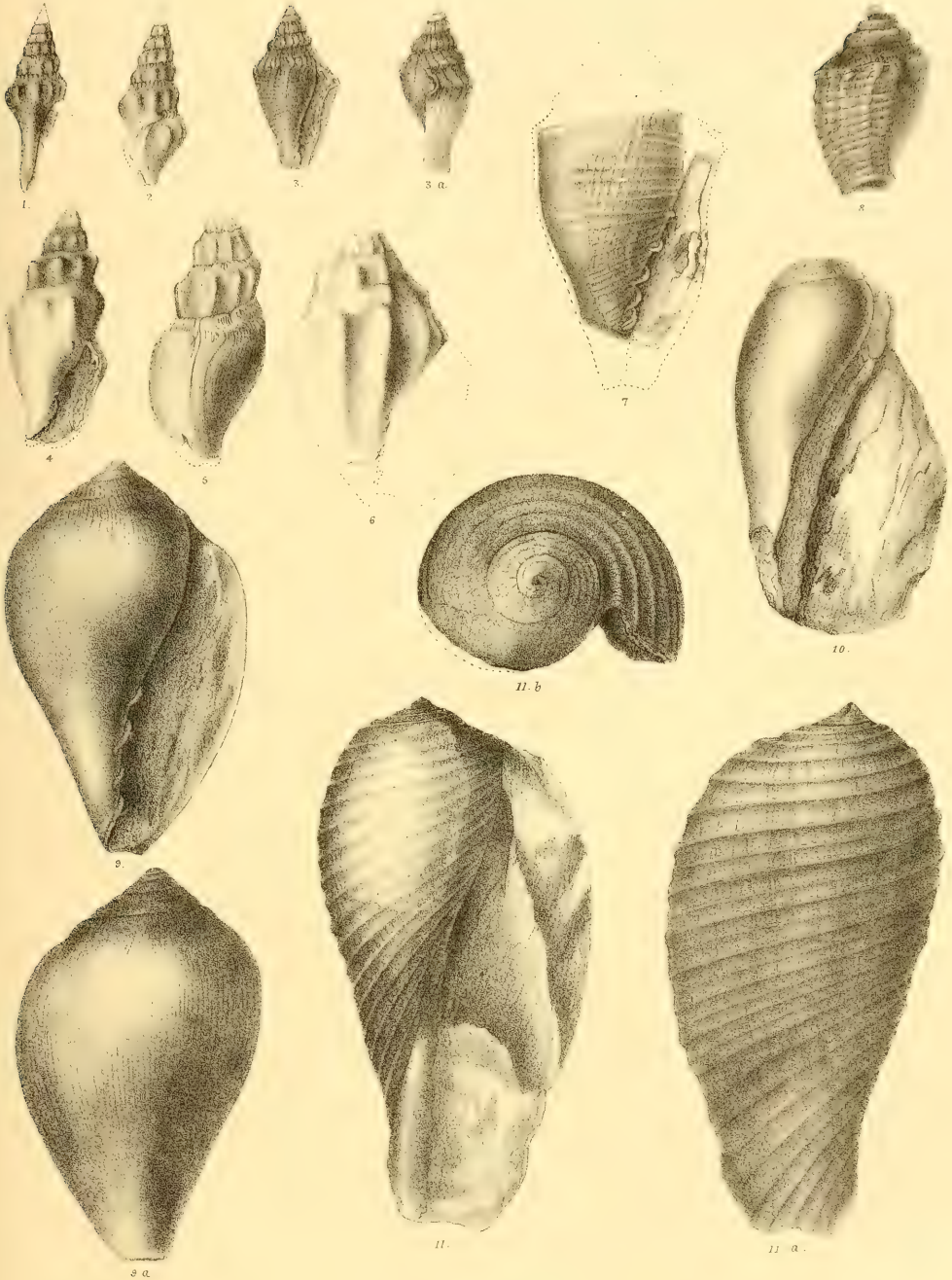

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PLATE VII.

Figs. 1—9. FULGURARIA ELONGATA, *D'Orb.*, sp., p. 87; specimens of different shape, in some of which the wanting portions of the shell have been restored in outline; see p. 88 for explanation of the different varieties; all the specimens are from the blueish or whitish sandstones stretching from *S. of Serdamungalum* towards *E. of Anapaudy; Trichinopoly group.*

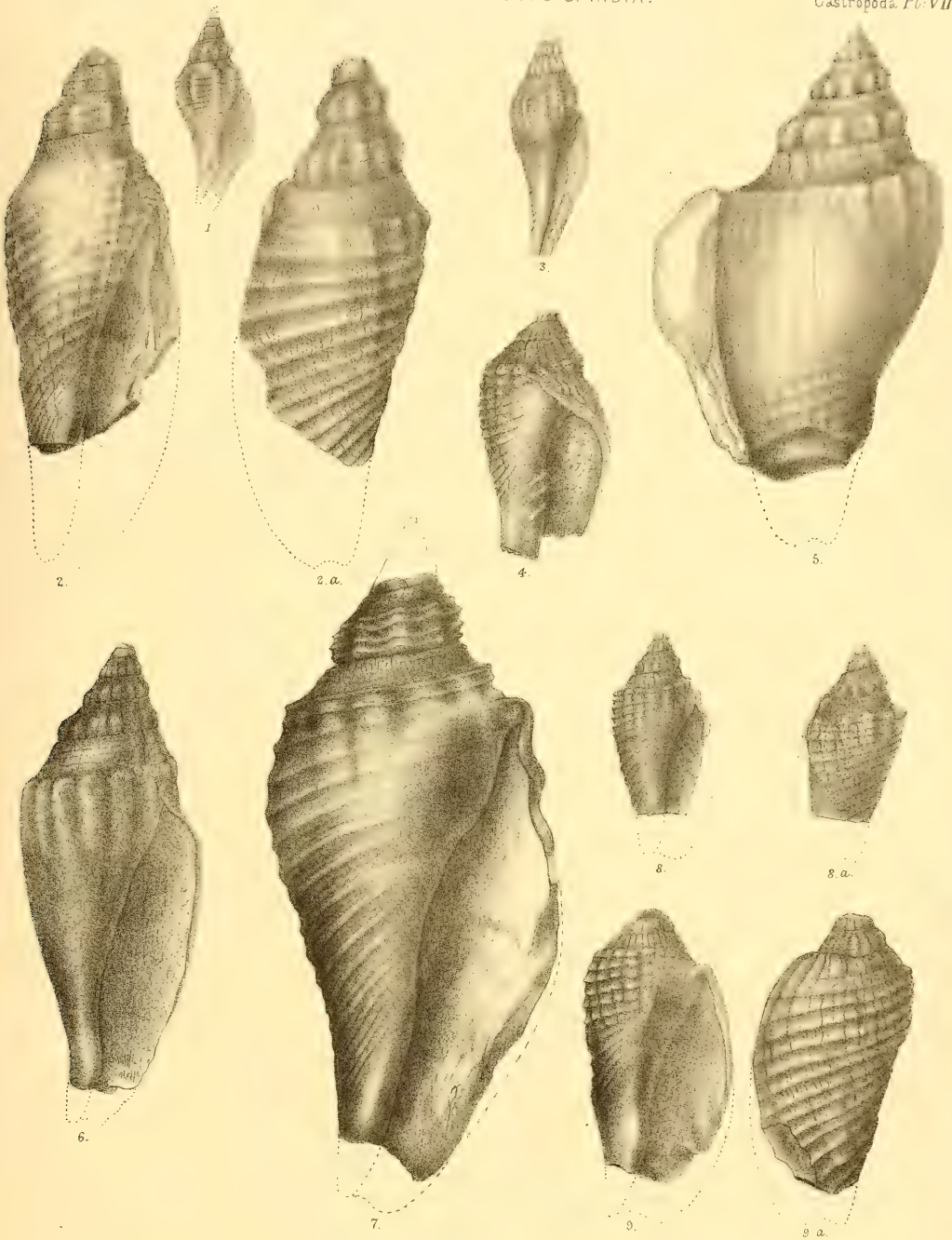

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PLATE VIII.

Figs. 1—3. FULGURARIA MULTISTRIATA, *Stol.*; p. 89; 1, front-view of an imperfect specimen with the four columellar plaits exposed; 2, another front-view of a small, and 3, back-view of a large specimen; the probable shape of the shell restored in outline; *E. of Anapaudy; Trichinopoly group.*

Figs. 4—7. ATHLETA PURPURIFORMIS, *Forbes*, sp.; p. 91; 4, front-view of the last whorl of an imperfect specimen, exhibiting the columellar plaits; 5, front-view of a nearly complete specimen, the posterior thickening on the margin of the aperture is specially marked; 6, back-view of an unusually inflated specimen, showing spiral striation only posteriorly, and the surface of the shell is all over perforated with some kind of shell-boring AMORPHOZOA; 7-7*a*, back-and side-views of a small specimen, showing spiral sulcation in the total height of the last whorl; the last figure exhibits the posterior direction of the striæ of growth towards the groove; 4 is from the blueish sandstones near *Pondicherry; Valudayur group;* the other specimens are from the neighbourhood of *Kullygoody; Trichinopoly group.*

Fig. ... 8. ATHLETA SCROBICULATA, *Stol.*; p. 92; front-, side-, and back-views of a specimen from *W.* of *Kullygoody; Trichinopoly group.*

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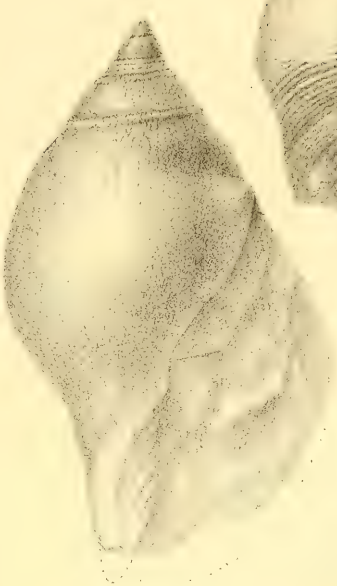
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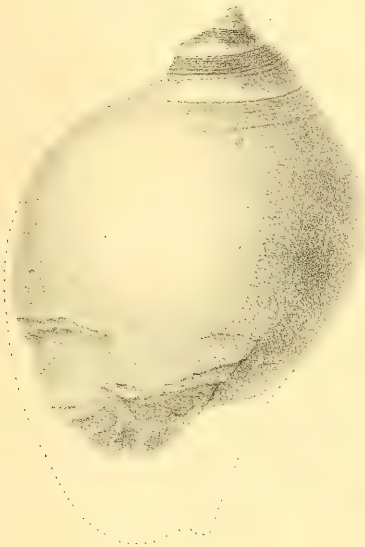
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8. b.

PLATE IX.

Figs. 1—2. VOLUTILITHES LATISEPTA, *Stol.;* p. 93; 1—1*a*, front-and back-views of a specimen with smooth embryonal whorls and a fine spiral striation on the last; 2, back-view of a remarkably large specimen with few distant ribs; both specimens from near *Cumalypooram; Arrialoor group.*

Figs. 3—4. VOLUTILITHES ACCUMULATA, *Stol.;* p. 94; 3—3*a*, front-and back-views, and 4, front-view; both specimens from the neighbourhood of *Olapaudy;* the anterior portions of the shell have been restored in outline; *Trichinopoly group.*

Fig. ... 5. VOLUTILITHES MURICATA, *Forbes*, sp.; p. 94; front-view of an imperfect specimen from the west of *Kullygoody;* ? *Trichinopoly group.*

Fig. ... 6. VOLUTILITHES RADULA, *Sow.*, sp.; p. 95; front-and back-views of a very nearly complete specimen from the whitish sandstones near *Kullygoody;* ? *Trichinopoly group.*

Figs. 7—8. LYRIA FORMOSA, *Stol.;* p. 97; 7—7 *a*, front-and back-views of a specimen of usual size, the anterior portion restored in outline from another specimen; 8 showing the disposition of the columellar plaits; *Ninnyoor; Arrialoor group.*

Fig. ... 9. LYRIA CRASSICOSTATA, *Stol.;* p. 98; front-and back-views; the shell surface is only partially preserved on the upper whorls; *Comarapolliam; Arrialoor group.*

Figs. 10—11. LYRIA GRANULOSA, *Stol.;* p. 99; 10—10 *a*, front-and back-views of a large specimen, and 11, a fragment exhibiting the disposition of the plaits on the inner lip; both from the whitish sandstones between *Andoor* and *Veraghoor? Trichinopoly group.*

Figs. 12—13. VOLUTOMITRA CANALICULATA, *Stol.;* p. 100; 12—12*a*, front-and back-views of a nearly complete specimen, but the aperture is too much obliterated by the adhering rock; 13, front-view of another specimen, showing two of the three columellar plaits present; near *Serdamungalum; Trichinopoly group.*

Fig. ... 14. MITREOLA CITHARINA, *Forbes*, sp.; p. 103; front-and back-views of an imperfect specimen, the figure having been completed according to that of Prof. Forbes in Geol. Trans.; *Pondicherry; Valudayur*-or *Arrialoor-group.*

Figs. 15—16. TURRICULA ARRIALOORENSIS, *Stol.;* p. 104; 15-15*a*, front-and back-views of a nearly complete specimen; in 16 the outer lip has been partly removed so as to show the plaits on the inner lip; *Comarapolliam; Arrialoor group.*

1

2.

1 a

3

4

3 a

5

6

6 a.

7.

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7 a

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9 a.

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10. a.

12

13.

12. a.

14.

14. a.

15.

16.

15 a

PLATE X.

Figs. 1—4. Latirus Reussianus, *Stol.*; p. 107; 1, front-view of an incomplete specimen showing the columellar plaits; 2, a specimen with much inflated last volution and shorter anterior canal; 3, complete specimen of usual form; 4, elongated specimen with the anterior canal complete; all from the neighbourhood of *Alundanapooram*; *Trichinopoly group*.

Figs. 5—7. Fasciolaria assimilis, *Stol.*; p. 110; 5, front-view of a small specimen, the transverse ribs being on it only little developed; 6, back-view, spiral striation and transverse ribs are very prominent; 7, front-view of a nearly complete specimen, the extreme margin of the outer lip being broken off, and the anterior termination restored in outline; 5 and 7 are from near *Olapaudy*, and 6 from the neighbourhood of *Mulloor*; *Trichinopoly group*.

Figs. 8—9. Fasciolaria carnatica, *Stol.*; p. 108; 8, back-view of a specimen from *Karapaudy*; 9, front-view of another from *Olapaudy*; *Arrialoor group*.

Figs. 10—16. Fasciolaria rigida, *Baily*, sp.; p. 109; 10, back-view of a nearly complete specimen, only the extreme termination of the canal being broken away; 11—15, front- and back-views of different specimens of various sizes with more or less numerous transverse ribs and spiral striæ; 16 exposes the three plaits on the inner lip; all specimens are from the same beds between *Serdamungalum* and *E.* of *Anapaudy*, as the Fulguraria elongata; *Trichinopoly group*.

Figs. 17—18. Hemifusus cinctus, *Stol.*; p. 114; 17-17*a*, front-and back-views; the anterior portion of the canal has been restored from another specimen, and can be considered as perfect; from between *Andoor* and *Veraghoor*; 18, front-view of an imperfect specimen with the spiral ribbings somewhat granulated; *Alundanapooram*; *Trichinopoly group*.

Fig. ... 19. Hemifusus acuticostatus, *Stol.*; p. 115; front-and back-views; the anterior canal restored according to its probable shape; *Comarapolliam*; *Arrialoor group*.

Fig. ... 20. Fusus verticillatus, *Stol.*; p. 122; front-and back-views; the outlines indicate the probable shape of the shell; *Odium*; *Ootatoor group*.

Fig. ... 21. Neptunea rhomboidalis, *Zekeli*, sp.; p. 120; front-and back-views of a nearly complete specimen; *Karapaudy*; *Arrialoor group*.

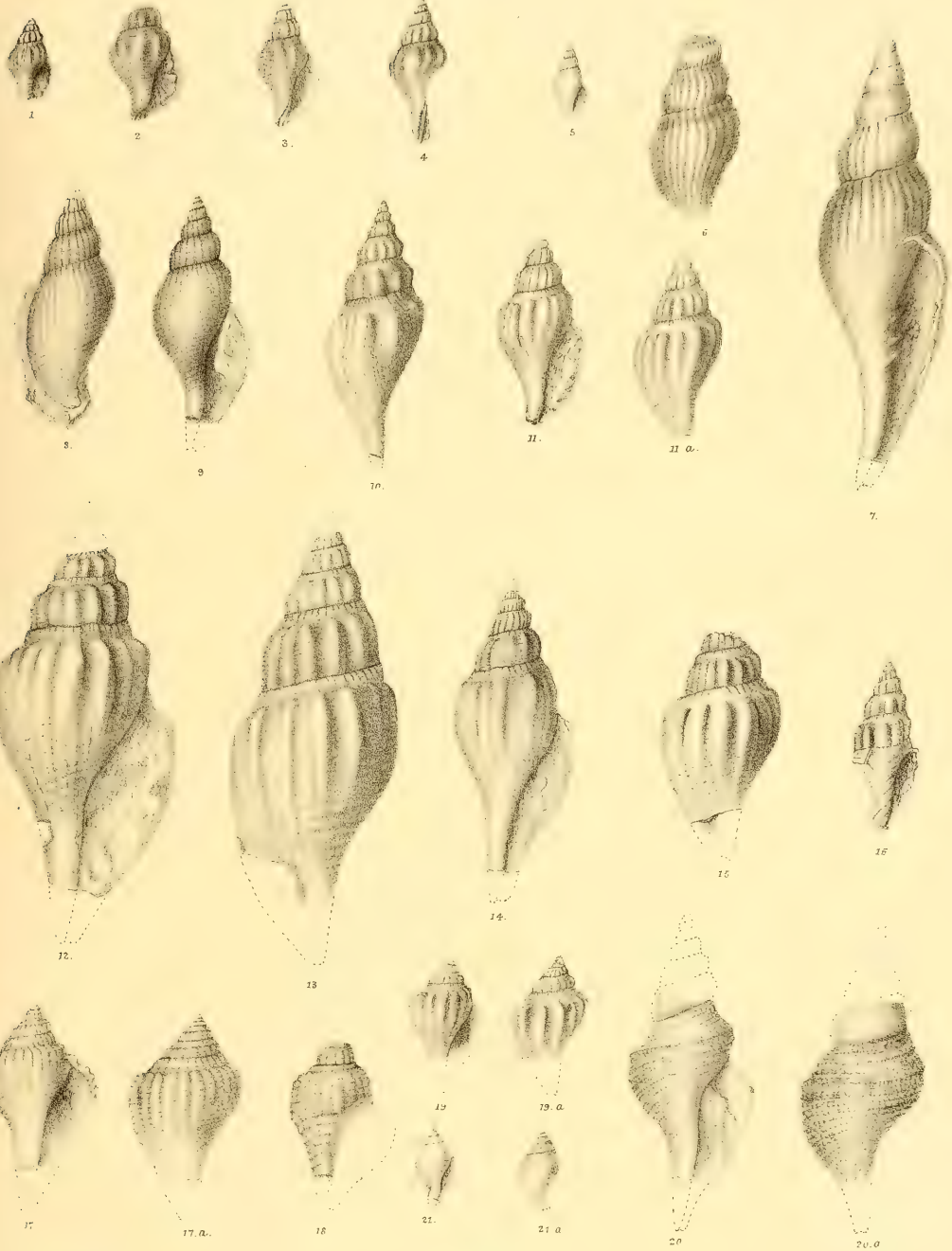

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PLATE XI.

Figs. 1—3. NEPTUNEA EXCAVATA, *Blanford,* sp.; p. 121; 1, front-view of a nearly complete specimen from *E. of Anapaudy;* 2, front-view of an elongated and 3, back-view of a somewhat inflated specimen; both from *N. of Kunnanore; Trichinopoly group.*

Fig. ... 4. TRITONIDEA TRICHINOPOLITENSIS, *Forbes,* sp.; p. 126; front-and back-views of a nearly complete specimen from near *Anapaudy; Trichinopoly group.*

Fig. ... 5. TRITONIDEA GIBBOSA, *Stol.;* p. 123; front-and back-views; near *Alundanapooram; Trichinopoly group.*

Figs. 6—7. TRITONIDEA GRANULATA, *Stol.;* p. 125; 6, back-view of a small specimen; 7-7*a*, front- and back-views of a larger specimen; the outlines indicate the probable shape of the shell; near *Parchairy;* in soft whitish sandstones; *Trichinopoly group.*

Figs. 8—9. TRITONIDEA REQUIENIANA, *D'Orb.;* p. 124; 8, back-view of a small specimen from *E. of Anapaudy;* 9-9*a*, front-and back-views of a specimen from between *Andoor* and *Veraghoor; Trichinopoly group.*

Figs. 10—12. POLLIA PONDICHERRIENSIS, Forbes, sp.; p. 127; 10-10*a*, front-and back-views of a nearly complete specimen; 11, a somewhat larger specimen with a high spire, and 12, back-view of a large specimen with a little more inflated last volution; the anterior outline indicates here the canal somewhat too long; all specimens are from the neighbourhood of *Anapaudy; Trichinopoly group.*

Fig. ... 13. TROPHON OLDHAMIANUM, *Stol.;* p. 129; front and back-views; the outlines indicate the probable shape; *S. of Serdamungalum; Trichinopoly group.*

Fig. ... 14. TRITONIUM GRAVIDUM, *Stol.;* p. 136; except on the outer lip, which has been restored from another specimen, nearly perfect; near *Arrialoor; Arrialoor group.*

Figs. 15—17. HINDSIA EXIMIA, *Stol.;* p. 135; 15-15*a*, front and back-views; the shape of the outer lip and anterior termination of the canal are completed from another specimen; 16, front-view, a small portion of the outer lip is posteriorly preserved; 17, back-view of a large specimen, the tubercles on the transverse ribs are more distinct than usually; 15 and 16 are from near *Arrialoor;* 17, *from Olapaudy; Arrialoor group.*

Fig. ... 18. LAGENA NODULOSA, *Stol.;* p. 137; front-and back-views; except the tip of the canal a complete specimen.

Figs. 19—20. LAGENA SECANS, *Stol.*; p. 138; 19*a*, cast; 20*a*, specimen with the shell; the outline is probably of the true shape; both from near *Olapaudy; Arrialoor group.*

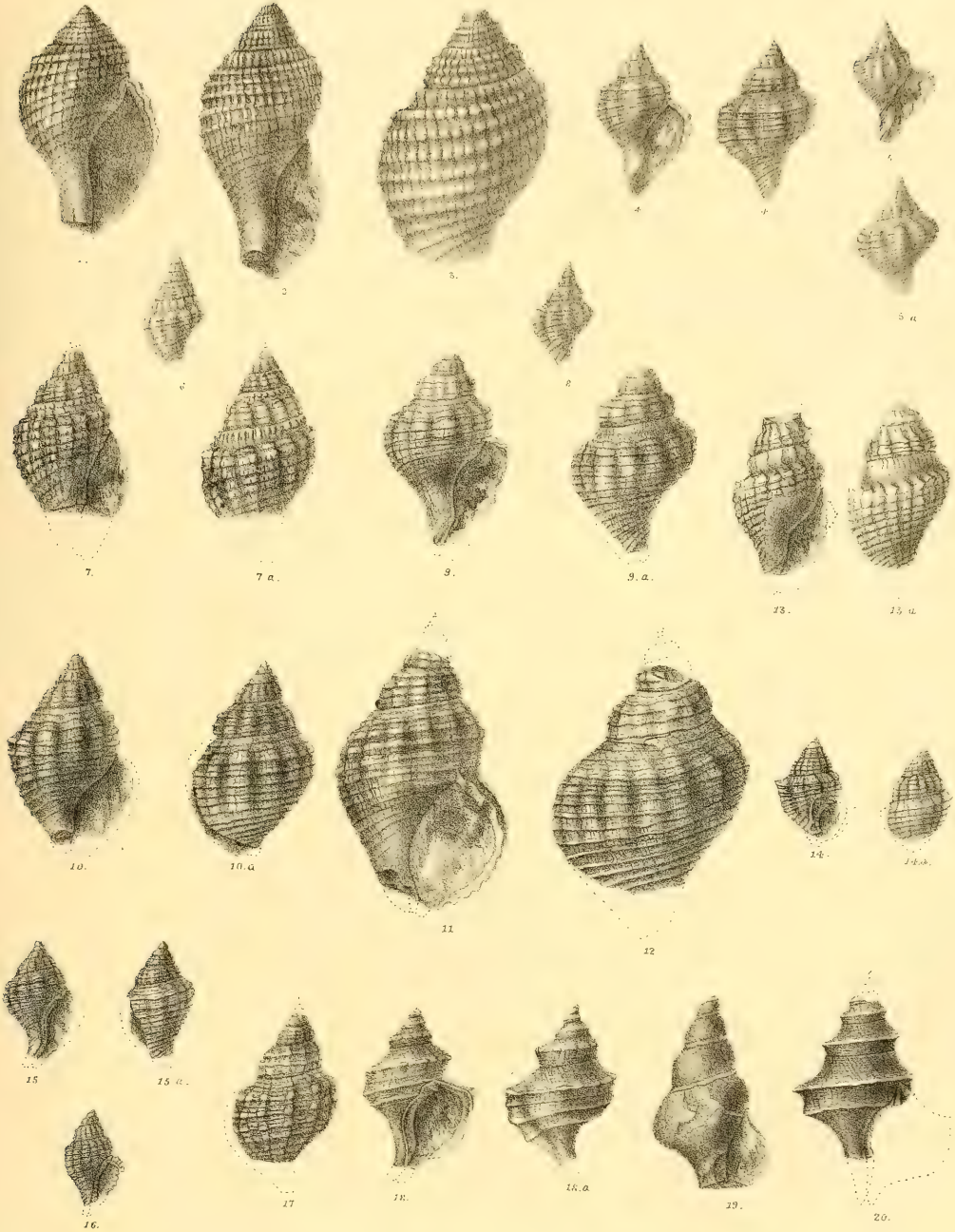

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PLATE XII.

Fig. ... 1. COLUMBELLINA, sp.; p. 139; front-and side-views of a cast specimen from near *Odium; Ootatoor group.*

Fig. ... 2. PSEUDOLIVA SUBCOSTATA, *Stol.;* p. 145; front- and back-views; the anterior termination has been restored to its probable shape; *Ninnyoor; Arrialoor group.*

Fig. ... 3. NASSA ARRIALOORENSIS, *Stol.;* p. 144; front- and back-views; the aperture partially restored; *Vaitagoody; Arrialoor group.*

Fig. ... 4. NASSA VYLAPAUDENSIS, *Stol.;* p. 144; 4, front-view; the aperture partially restored from another specimen; 4*a*, one whorl increased, showing the disposition of the transverse ribs and spiral striæ; *Vylapaudy; Arrialoor group.*

Figs. 5—8. TUDICLA EXIMIA, *Stol.;* p. 151; 5, front-view of a well preserved specimen with the aperture, the canal has been indicated in outline; 6, back-view, a small specimen with two anterior, thinner keels; 6*a*, top-view of the same; 7, back-view of a large specimen with only two keels, which become obsolete near the aperture; 8, back-view of a cast; and 8*a*, top-view of the same; all specimens are from the neighbourhood of *Karapaudy; Arrialoor group.*

Fig. ... 9. RAPA ANDOORENSIS, *Stol.;* p. 153; front-and back-views of a well preserved large specimen; the anterior termination of the canal is only indicated in outline; *Andoor; Trichinopoly group.*

Figs. 10—11. RAPA NODIFERA, *Stol.;* p. 153; 10, front-, 10*a*, back-views of a large specimen, the canal being only indicated; 11, a small specimen; both from near *Coonum; Trichinopoly group.*

Figs. 12—16. RAPA CANCELLATA, *Sow.*, sp.; p. 154; 12 a small specimen with the extreme margin of the outer lip broken off, but with the anterior canal almost perfect; from near *Serdamungalum;* 13-16, specimens of different sizes with the outer and inner lips mostly well preserved, the columella becoming gradually more excavated, as the size of the shell increases, while the anterior canal appears to become shorter in proportion; all specimens from *W. of Kullygoody; Trichinopoly group.*

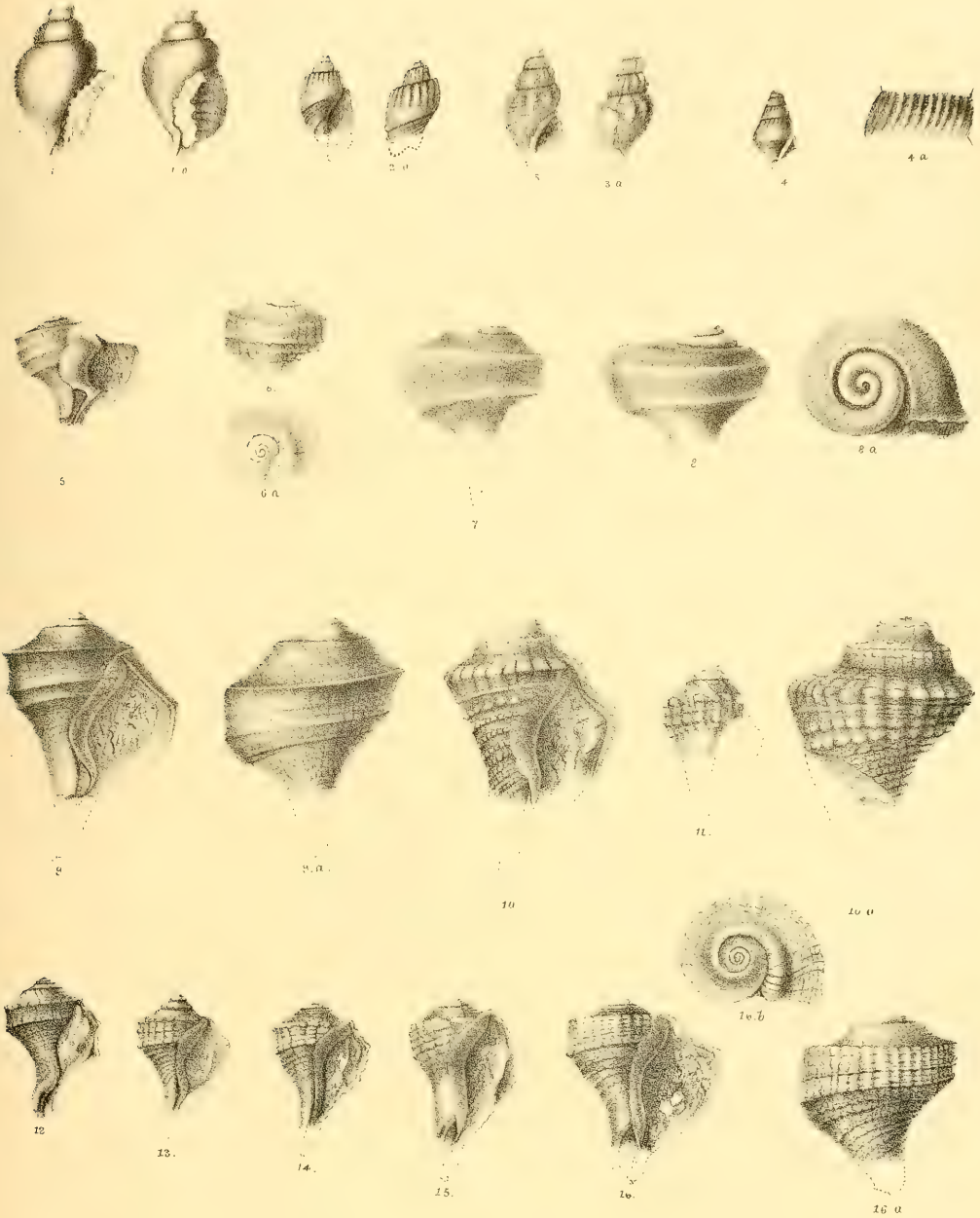
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PLATE XIII.

Figs. 1—4. RAPA CANCELLATA, *Sow.*, sp.; p. 154; 1, front-view of a large specimen with perfect margin of the outer lip; from *E. of Anapaudy*; 2, back-view of a specimen with two stronger peripherical keels; 3-3*a*, front-and back-views of specimen with more evenly convex last whorl; both are from near *Kolakonuttom*; 7, back-view of a specimen with the transverse ribs somewhat stronger, than is usually the case; from *E. of Anapaudy; Trichinopoly group.*

Fig. ... 5. RAPA CORALLINA, *Stol.;* p. 155; front-and back-views of a small specimen; the outer lip is partially perfect, but the anterior canal is only indicated by an outline; *Ninnyoor; Arrialoor group.*

Fig. ... 6. RAPANA TUBERCULOSA, *Stol.;* p. 156; front-and back-views of a small specimen; *Serdamungalum; Trichinopoly group.*

Figs. 7—9. TRICHOTROPIS KONINCKI, *Müller*, sp.; p. 158; 7, back-view of a large specimen, with much elevated spire; 8, front-view of a smaller specimen with shorter spire; the inner lip is perfect, and the margin of the outer lip nearly so; 9, back-view of a portion of the spire; all specimens from *E. of Anapaudy; Trichinopoly group.*

Fig. ... 10. TRICHOTROPIS NODULOSA, *Stol.;* p. 159; front-and back-views of a somewhat incomplete specimen; *S. W.* of *Alundanapooram; Trichinopoly group.*

Fig. ... 11. CANCELLARIA ANNULATA, *Stol.;* p. 162; front-and back-views; the anterior termination of the shell is only indicated in outline; *Olapaudy; Arrialoor group.*

Fig. ... 12. CANCELLARIA (EUCLIA) BREVIPLICATA, *Forbes*, sp.; p. 163; front-and back-views; the anterior termination is restored in outline; *Comarapolliam; Arrialoor group.*

Fig. ... 13. CANCELLARIA (EUCLIA) INTERCEDENS, *Stol.;* p. 164; front-and back-views; only the apex and the extreme margin of the outer lip are not perfect in the specimen; *Comarapolliam; Arrialoor group.*

Fig. ... 14. CANCELLARIA (EUCLIA) CAMDEO, *Forbes*, sp.; p. 165; front-and back-views; only the posterior portion of the outer lip is imperfect; near *Comarapolliam; Arrialoor group.*

Figs. 15—16. NARONA EXIMIA, *Stol.;* p. 166; 15-15 *a*, front-and back-views of a complete specimen; 16, front-view of another with more inflated last volution and a shorter spire; from near *Alundanapooram; Trichinopoly group.*

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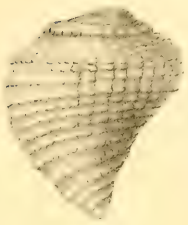
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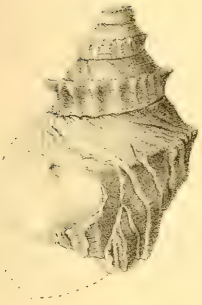
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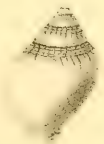
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PLATE XIV.

Fig. ... 1. ITRUVIA GLOBOIDES, *Stol.*; p. 182; front-and top-views of a somewhat imperfect specimen; from a light colored sandstone near *Comarapolliam*; *Arrialoor group.*

Fig. ... 2. NERINEA INCAVATA, *Bronn*; p. 183; α and β, views of two specimens, completing each other; 2a, section of one whorl showing the distribution of the internal folds; from conglomeratic sandstones near *Parully*; *Ootatoor group.*

Fig. ... 3. TURRITELLA ELICITA, *Stol.*; (*vide* postea, family *Turritellidæ*); α, β, γ, δ, views of different small specimens; 3*a*, section of another small specimen showing the considerable thickness of the shell; *Ninnyoor*; in white limestone; *Arrialoor group.*

Figs. 4—6. NERINEA BLANFORDIANA, *Stol.*; p. 184; 4, back-view of a large specimen from the coral limestones near *Moraviatoor*; the surface of the shell is considerably worn off; 5, section of a few whorls, showing merely their shape; the columellar folds are not visible, because the section is not taken through the axis; from the same locality as the last; 6, small fragment having the marginal tubercles distinct, and exhibiting the columellar plaits; from the conglomeratic sandstones near *Parully*; *Ootatoor group.*

Fig. ... 7. NERINEA sp. p. 185; front-view of a cast and section of one whorl, showing the internal folds; *Moraviatoor*; *Ootatoor group.*

Fig. ... 8. ACTÆONELLA TRUNCATA, *Stol.*; (*vide* postea, family *Actæonidæ*); front-and top-views of a somewhat imperfect specimen; near *Shillagoody*; *Arrialoor group.*

Figs. 9—14. ACTÆONELLA CYLINDRACEA, *Stol.*; (*vide* postea, family *Actæonidæ*); front-views of different specimens of sizes; in Fig. 2 the anterior termination of the aperture is perfect; Fig. 13 is a cast from near Andoor; all the other specimens are from the neighbourhood of *Kolakonuttom*; *Ootatoor group.*

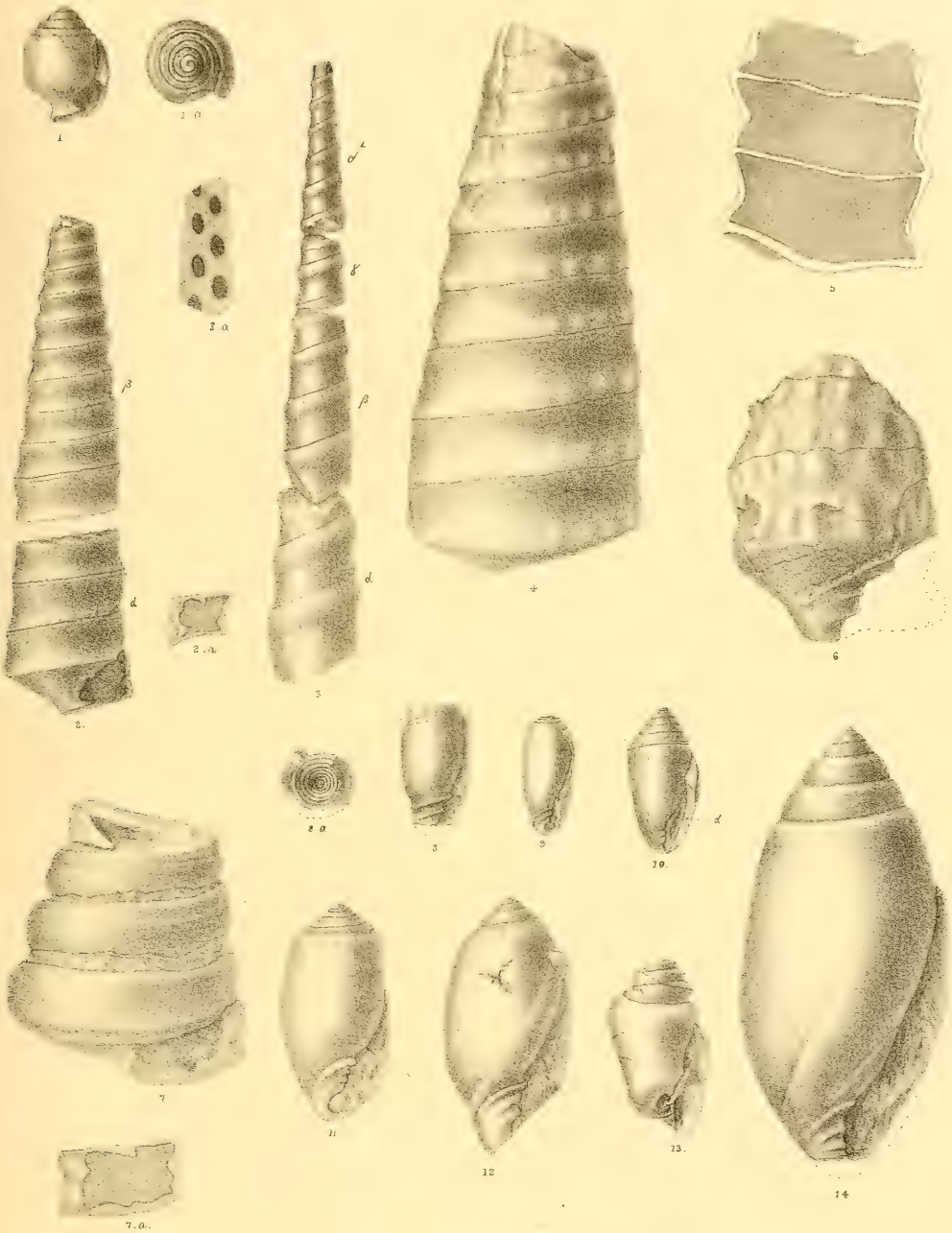
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PLATE XV.

Fig. ... ... 1. CERITHIUM (FIBULA?) DETECTUM, *Stol.*; p. 192; front-and back-views; the anterior canal has been indicated by an outline; *Karapaudy; Arrialoor group.*

Figs. ... 2—5. CERITHIUM ARCOTENSE, *Stol.*; p. 197; front-and back-views of different specimens; in Figs. 2 and 3 the apertures are perfect; all from the sandstones near *Coothoor; Arrialoor group.*

Figs. ... 6—7. CERITHIUM (EXELISSA?) SCALAROIDEUM, *Forbes*; p. 201; 6, front-view of a specimen with nearly perfect aperture; 6*a*, view of the basis of the same; 7, front-view of another specimen with somewhat eroded surface, making the finer ornamentation less distinct; from the neighbourhood of *Alundanapooram; Trichinopoly group.*

Fig. ... ... 8. CERITHIUM LASSULUM, *Stol.*; p. 198; back and basal-views of natural size; *Vylapaudy; Arrialoor group.*

Fig. ... ... 9. CERITHIUM TRIMONILE, *Mich.*; p. 199; 9 and 9*a*, front-and basal-views of a nearly perfect specimen, but with the granulation of the surface somewhat eroded; 9*b*, one whorl enlarged to three times the linear measurements; *Karapaudy; Arrialoor group.*

Fig. ... ... 10. CERITHIUM CLARANDUM, *Stol.*; p. 198; 10, front-view of an imperfect specimen; 10*a*, one whorl enlarged to four times the linear measurements; *Anpaudy; Trichinopoly group.*

Figs. ... 11—12. CERITHIUM FERTILE, *Stol.*; p. 200; 11, front-view of a cast; 12, front-view of an imperfect specimen with preserved shell surface (*vide* Pl. XIX, Fig. 5); the aperture has been indicated in outline; near *Odium; Ootatoor group.*

Figs. ... 13—14. CERITHIUM LIMBATUM, *Stol.*; p. 194; 13, front-view of a somewhat imperfect specimen, but with well preserved shell-surface; 14, represents a fragment of a large specimen, which belongs probably to the same species; *Coothoor; Arrialoor group.*

Figs. 15, 19, and 20. CERITHIUM INAUGURATUM, *Stol.*; p. 193; 15, front-view of a cast from *Alundanapooram; Trichinopoly group;* 19, 20, views of two fragmentary specimens of sizes with the shell partially well preserved; from the light colored sandstones near *Comarapolliam; Arrialoor group.*

Figs. 16, 17, and 18. CERITHIUM HISPIDULUM, *Stol.*; p. 194; back-views of different, more or less imperfect, specimens; the shell-surface is mostly well preserved; 16 and 18 are from the S. of *Serdamungalum;* 17 from *Kolakonuttom; Trichinopoly group.*

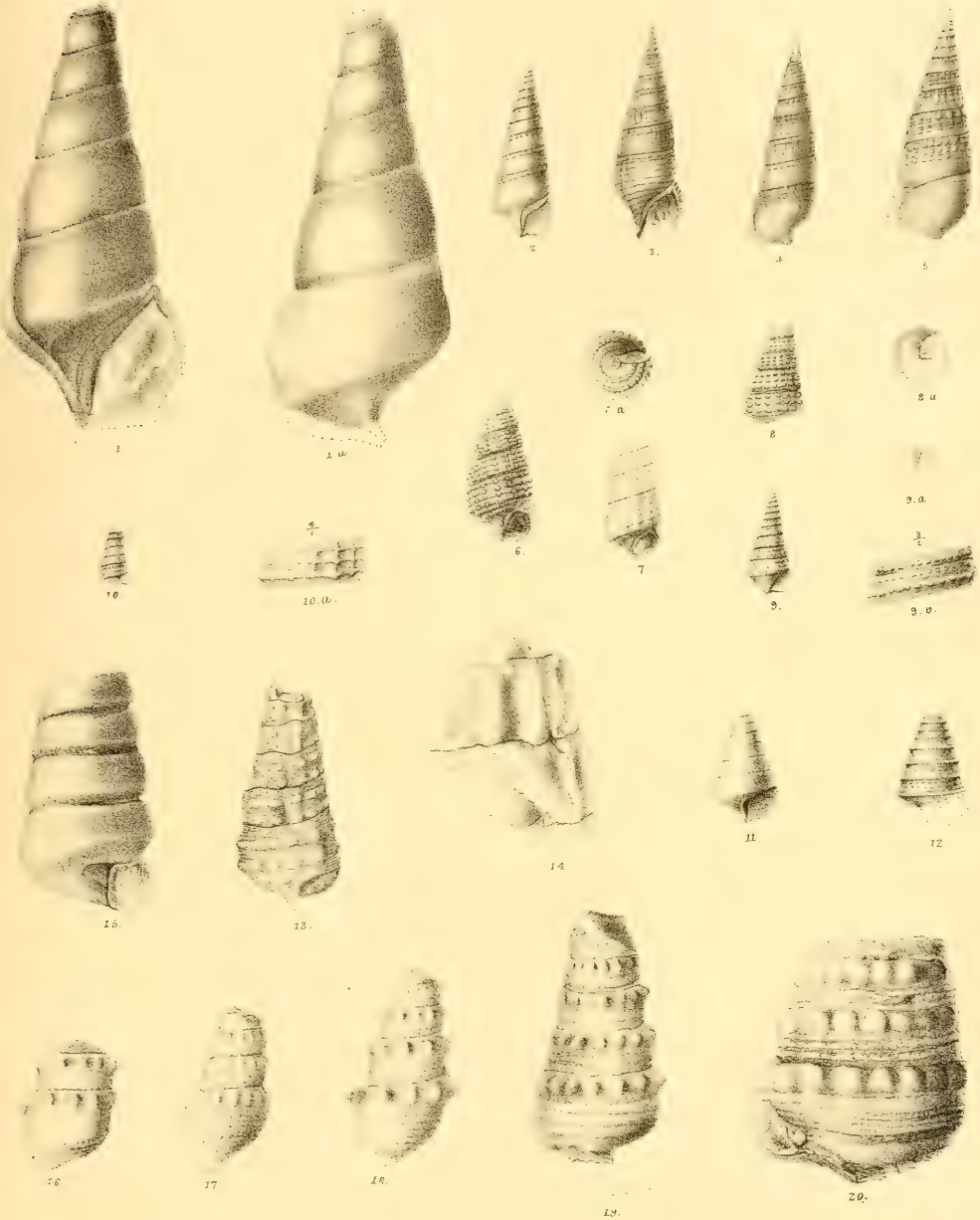
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PLATE XVI.

Figs. 1—2. Cerithium carnaticum, *Stol.*; p. 195; 1, front-and back-views of a large specimen with the shell partially preserved; it is wanting on the last whorl near the aperture; 2, a smaller specimen with the spiral striation better preserved; *Veraghoor*; *Arrialoor group*.

Figs. 3—4. Cerithium vagans, *Stol.*; p. 196; two imperfect specimens, having the shell surface only partially preserved; 3 is from *Garudamungalum*; *Trichinopoly group*; 4 from near *Karapaudy*; *Arrialoor group*.

Fig. ... 5. Cerithium (Sandbergeria) antecedens, *Stol.*; p. 202; front and basal-views in natural size; 5*b*, one whorl enlarged three times the linear measurements; vide Pl. XIX, Fig. 4; *Shillagoody*; *Arrialoor group*.

Figs. 6—8. Cerithium (Sandbergeria?) crispicans, *Stol.*; p. 203; 6, front-view of a small but nearly perfect specimen with the shell surface much worn off; 7, back-view of a well preserved specimen, and 7*a*, enlarged whorl of the same; 8, the last volution of another well preserved specimen, enlarged three times; all specimens from the neighbourhood of *Arrialoor*; *Arrialoor group*.

Fig. ... 9. Rissoa Oldhamiana, *Stol.*; (*vide* postea, family *Rissoidæ*); front-and side-views, and one whorl enlarged four times; the specimen is very nearly perfect, and another representation of the same will be found on Pl. XX, Fig. 18; *Garudamungalum*; *Trichinopoly group*.

Figs. 10—11. Turritella (Torcula) gemina, *Stol.*;* 10, front-and basal-views of a nearly perfect specimen (*vide* Pl. XIX, Fig. 9); *Arrialoor*; 11, another fragmentary specimen with the whorls somewhat more excavated; *Karapaudy*; *Arrialoor group*.

Fig. ... 12. Arcotia indica, *Stol.*; front-and basal-views; *Alundanapooram*; *Trichinopoly group*.

Figs. 13—14. Turritella (Torcula) dispassa, *Stol.*; front-and back-views of different specimens of sizes (*vide* Pl. XIX, Figs. 10-11); *Arrialoor*; *Arrialoor group*.

Fig. ... 15. Turritella nerinea (?), *Röm.*; a small fragmentary specimen (*vide* Pl. XIX, Figs. 18-19); *W.* of *Odium*; *Ootatoor group*.

Fig. ... 16. Turritella Neptuni, *Münst.*; a fragmentary specimen from *Alundanapooram*; *Trichinopoly group* (*vide* Pl. XIX, Fig. 14).

Fig. ... 17. Turritella contumescens, *Stol.*; fragmentary specimen (*vide* Pl. XIX, Fig. 17); from near *Comarapolliam*; *Arrialoor group*.

Figs. 18—19. Turritella (Torcula) Pondicherriensis, *Forb.*; 18*a*, fragment belonging to the top whorls; 19 another including the last volution; from near *Pondicherry*; *Arrialoor group* (?).

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* The description of this and the following species of the *Turritellidæ* will be found in the succeeding parts.

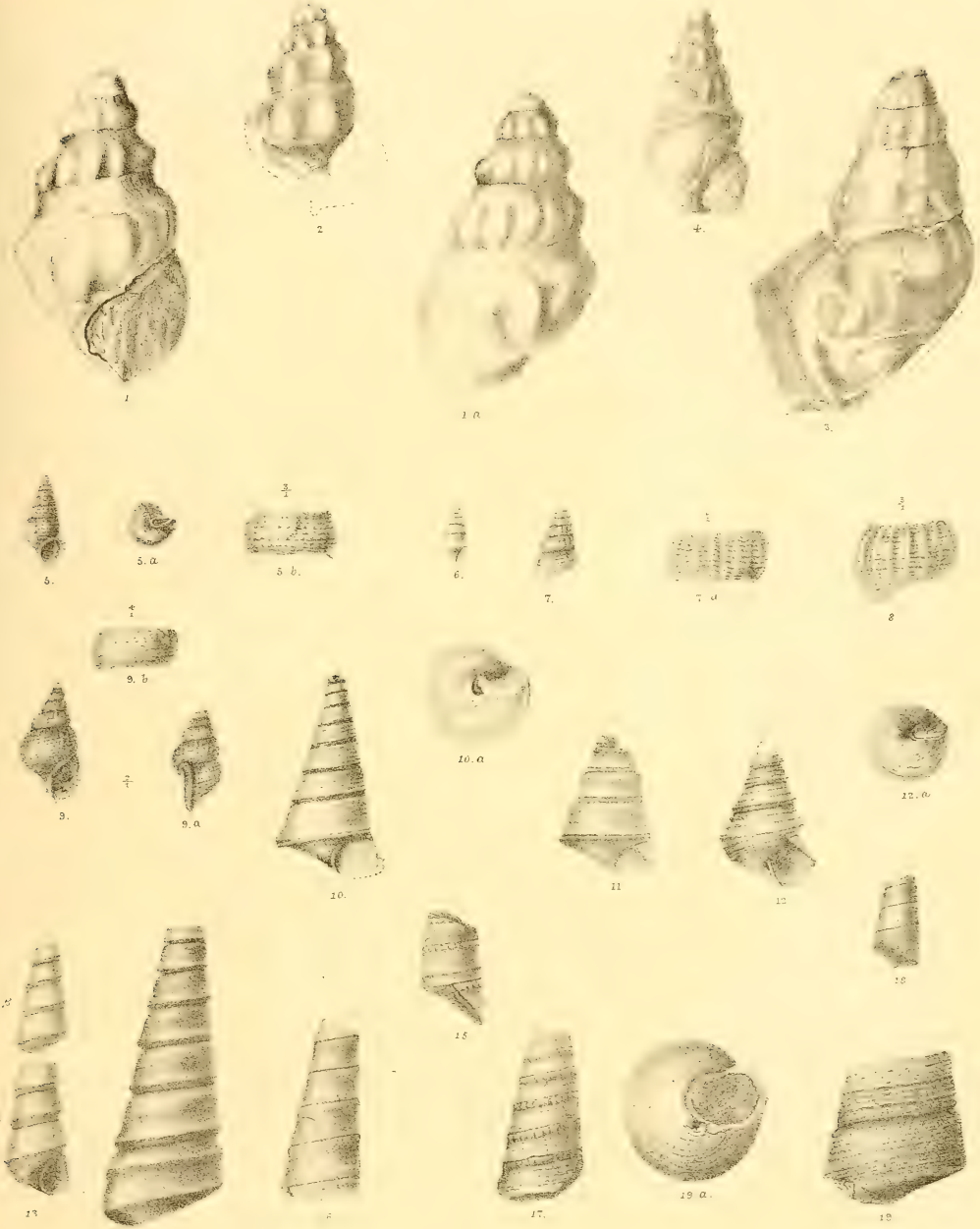

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PLATE XVII.

Fig. ... 1. TURRITELLA (TORCULA) ASPERATA, *Stol.*, p. 116, 1, front-view; 1a, view of the base; *Ninnyoor*; *Arrialoor group* (see Pl. XIX, Fig. 7).

Figs. 2—6. TURRITELLA (ZARIA) BREANTIANA, *d'Orb.*, p. 227, views of different specimens from near *Veraghoor*; *Trichinopoly group*.

Fig. ... 7. TURRITELLA NODOSA, Röm., p. 222, two fragments completing each other; *Odium*; *Ootatoor group* (see Pl. XIX, Figs. 20-21).

Figs. 8, 14, 16. TURRITELLA (ZARIA) MULTISTRIATA, *Reuss*, p. 224; 8, side-view of a fragment with the margin of the outer lip perfect; 9,10,16, fragments consisting of the top-whorls, showing variations in the disposition of the spiral ridges; 11, front-view with perfect aperture; 13, 14, casts of top-whorls; all the specimens from the sandy beds near *Comarapolliam* and *Arrialoor*; *Arrialoor group*.

Fig. ... 15. TURRITELLA (ZARIA) VENTRICOSA, *Forbes*, p. 227, front-view of a somewhat imperfect specimen; *Ninnyoor*; *Arrialoor group* (see Pl. XIX, Figs. 22-23).

Figs. 17, 18. TURRITELLA (TORCULA) AFFINIS, *Müller*, p. 219; 17, front-view of a nearly perfect specimen; 17a and 18, single whorls, enlarged; in light coloured sandstone near *Coonum*; *Trichinopoly group* (see Pl. XIX, Figs. 12-13).

Figs. 19, 20, 21. CHEMNITZIA UNDOSA, *Forbes*, p. 286; 19, a specimen with a remarkably thickened inner lip, from *Garudamungalum*; 20, a variety with numerous, transverse, ribs; 21, specimen with nearly perfect aperture, the outer lip being very thin and showing posteriorly a distinct insinuation; from *S. of Serdamungalum*; *Trichinopoly group*.

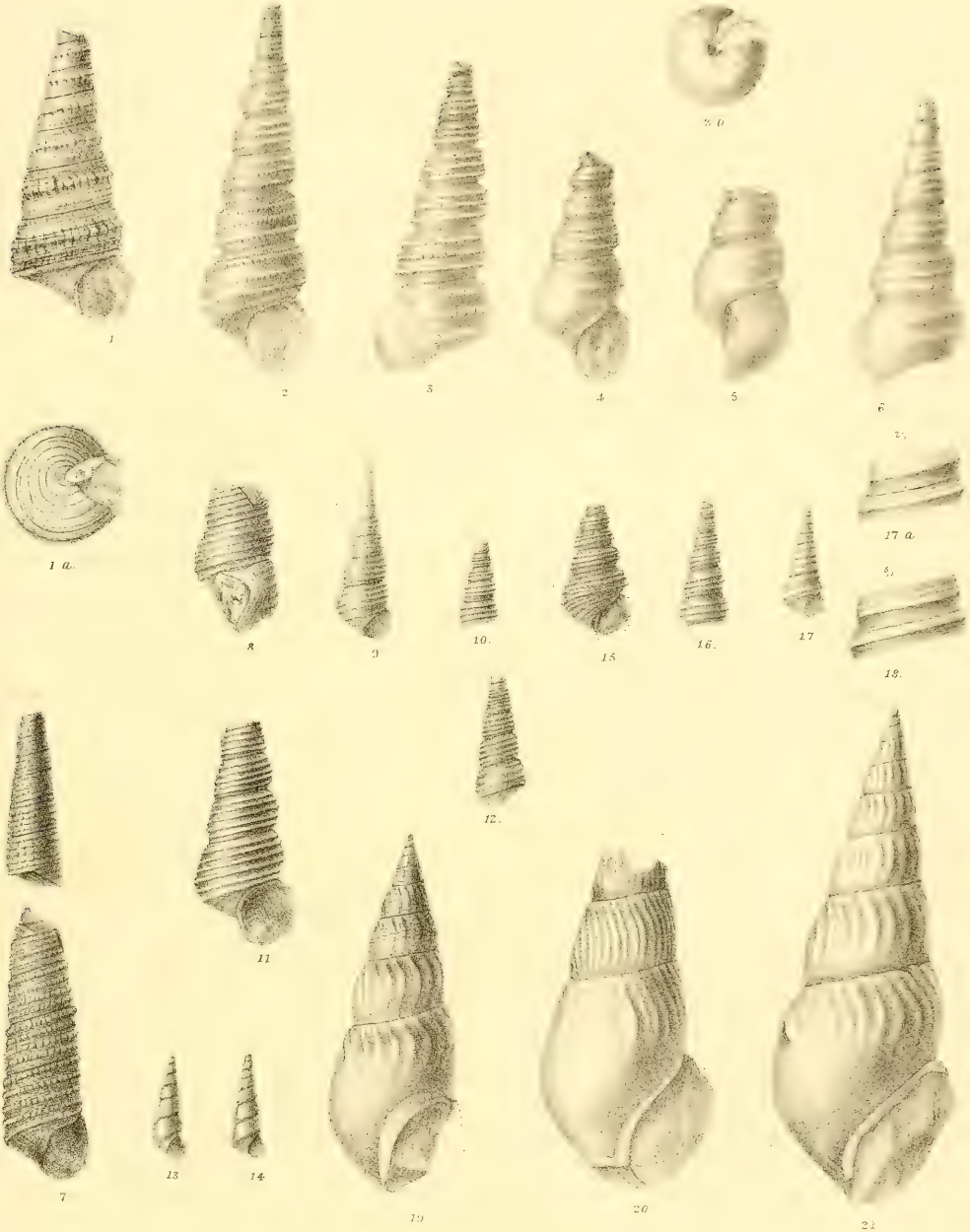
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PLATE XVIII.

Fig. ... 1. Scala Clementina, *Michelin*, (var ?), p. 231, an imperfect specimen, the probable shape restored in outline; *Odium; Ootatoor group.*

Figs. 2—3. Scala subturbinata, *d'Orb.*, p. 232; 2, a small specimen with the margins of the aperture perfect; 2a, view of the basis; 2b, a small portion of the surface of the shell enlarged eight times; 3, 3a, 3b, respective views of another larger but less perfect specimen; *Arrialoor; Arrialoor group.*

Figs. 4—5. Scala striatocostata, *Müller*, p. 233, views of two different specimens; 4a, showing the lateral compression and height of the transverse ribs; 4b, an enlarged portion of the surface exhibiting the spiral striation; *Comarapolliam; Arrialoor group.*

Figs. 6—8. Scala Shutanurensis, *Stol.*, p. 233, views of different specimens; 7a, being an enlarged portion of the surface of the shell; *Shutanure; Trichinopoly group.*

Figs. 9—10. Thylacodes lamellosus, *Stol.*, p. 243; 9, front; 9a, top-view of the same specimen, apparently full grown; 10, a fragment of a young specimen; *Comarapolliam; Arrialoor group.*

Figs. 11—19. Burtinella concava, *Sow.* sp., p. 242; 11, section of a full grown specimen; 12, enlarged view of a section of the shell, showing the three distinct layers,—a, being the internal cavity of the whorl, b, internal layer, c, median, d, external; 13, 14, 15, 17, are views of the base of different specimens; 14 and 16, top-views; 14a, 18, and 19, front-views, the last representing a specimen which is coiled from right to left, while all the other specimens in our collection are coiled from left to right; most of the specimens are from the sandstones between *Andoor* and *Veraghoor*; *Arrialoor group.*

Figs. 20—25. Tubulostium discoideum, *Stol.*, p. 240; 20, top-view of a specimen with very much produced aperture; 21, the same view of another specimen; 22, front-view; 23, enlarged section of the shell,—a, being the internal space of the whorl, b, internal layer of the shell, c, median, d, external, e, external callosity; 24, section of the shell; 25, peripherical view of the same; *Odium; Ootatoor group.*

Figs. 26—32. Tubulostium callosum, *Stol.*, p. 241; 26, section of a specimen; 27, section of the shell,—a, being the internal space of a whorl, b, internal layer, c, median, d, external, e, external callosity; 28, 29, 31, front-views of different specimens; 29a and 32, views of the base, showing the large development of the callosity; 30 back-view; *N. of Ootatoor; Ootatoor group.*

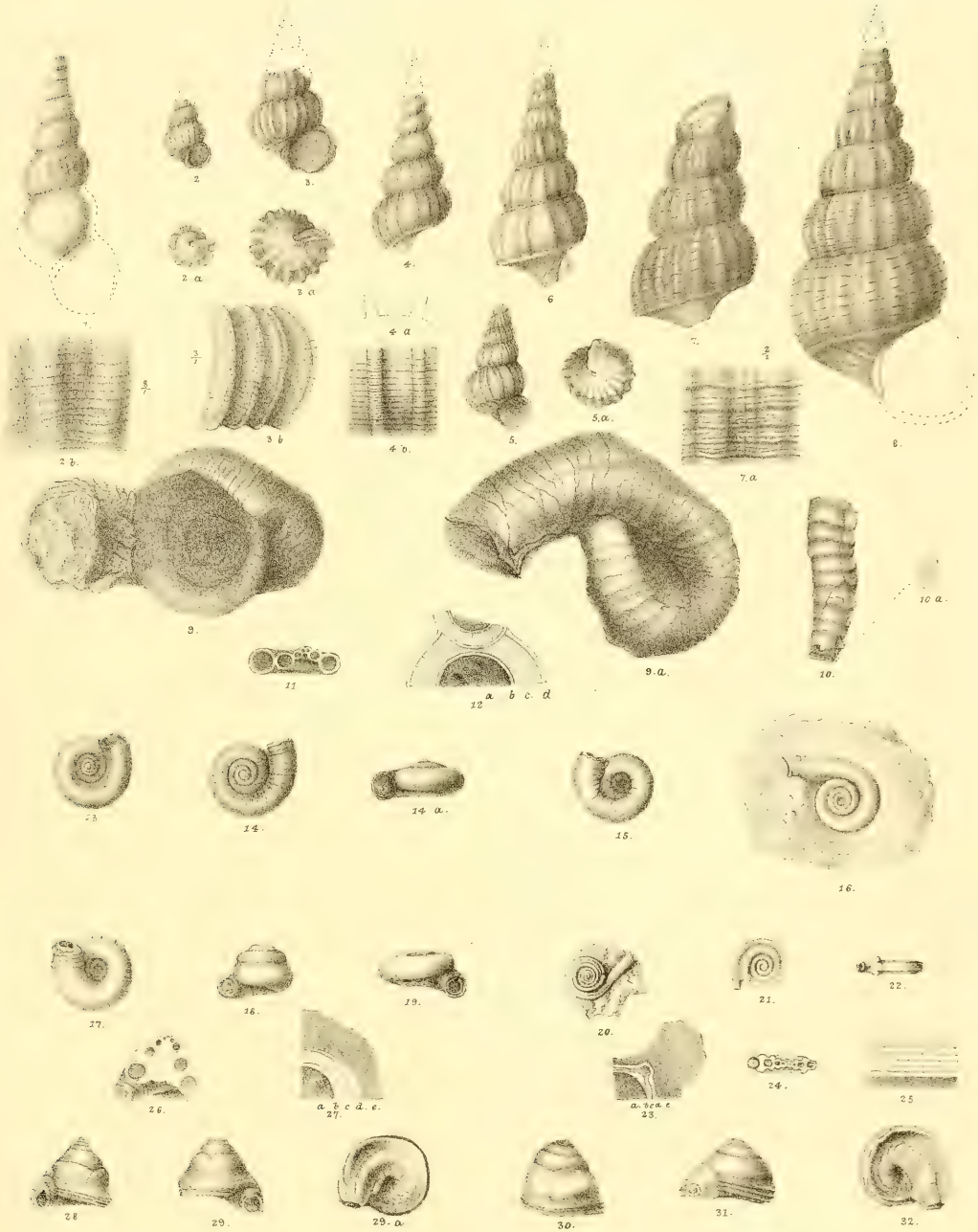
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PLATE XIX.

Fig. ... 1. CERITHIUM LASSULUM, *Stol.*, p. 198; one whorl, enlarged to three times natural size, of the specimen figured in Pl. XV, Fig. 8.

Figs. 2—3. CERITHIUM TRIMONILE, *Michelin*, p. 199; 2, a portion of a whorl enlarged four times; 3, a nearly complete specimen enlarged twice.

Fig. ... 4. CERITHIUM TRICHINOPOLITENSE, Forbes (see Appendix and *C. antecedens*, p. 202); enlarged view of a small, nearly perfect specimen with the tuberculations somewhat obsolete; *Comarapolliam; Arrialoor group.*

Fig. ... 5. CERITHIUM FERTILE, *Stol.*, p. 200; a portion of a whorl enlarged five times of the specimen represented in Fig. 12 of Pl. XV.

Fig. ... 6. ARCOTIA INDICA, *Stol.*, p. 215; enlarged portion of one whorl; see Pl. XVI, Fig. 12.

Fig. ... 7. TURRITELLA (TORCULA) ASPERATA, *Stol.*, p. 216; magnified portion of one whorl; see Pl. XVII, Fig. 1.

Fig. ... 8. TURRITELLA (TORCULA) PONDICHERRIENSIS, *Forb.*, p. 217; magnified portion of a whorl; see Pl. XVI, Figs. 18, 19.

Fig. ... 9. TURRITELLA (TORCULA) GEMINA, *Stol.*, p. 218; two enlarged figures of portions of one of the upper, and of the last, whorls; see Pl. XVI, Figs. 10, 11.

Figs. 10—11. TURRITELLA (TORCULA) DISPASSA, *Stol.*, p. 218; 10, being an enlarged figure of a portion of one of the whorls of specimen of Fig. 13, Pl. XVI; 11 is a natural size figure of a fragment of an old shell.

Figs. 12—13. TURRITELLA (TORCULA) AFFINIS, *Müll.*, p. 219; enlarged portions of whorls with slight differences in the ornamentation; see Pl. XVII, Figs. 17, 18.

Fig. ... 14. TURRITELLA NEPTUNI, *Münst.*, p. 220; enlarged portion of a whorl of the specimen represented in Fig. 16, Pl. XVI.

Figs. 15—16. TURRITELLA ELICITA, *Stol.*, p. 221; 15, a portion of one of the top whorls enlarged eight times; 16, a portion of one of the last whorls, natural size.

Fig. ... 17. TURRITELLA CONTUMESCENS, *Stol.*, p. 221; enlarged portion of a whorl of the specimen, Fig. 17, Pl. XVI.

Figs. 18—19. TURRITELLA? NERINEA, *Röm.*, p. 222; 18 is the figure of a specimen, part of which was represented in Fig. 15, Pl. XVI; 19, a much magnified portion of a whorl.

Figs. 20—21. TURRITELLA NODOSA, *Röm.*, p. 222; two enlarged portions of whorls showing slight differences in the arrangement of the spiral ribbings; see Pl. XVII, Fig. 7.

Figs. 22—23. TURRITELLA (ZARIA) VENTRICOSA, *Forb.*, p. 227; 22, enlarged portion of one of the whorls; 23, similar of one of the last whorls of an old shell; see Pl. XVII, Fig. 15.

Fig. ... 24. XENOPHORA CARNATICA, *Stol.*, p. 247; 24, front-, 24 a, basal-view, 24 b, enlarged whorl; *Comarapolliam, Arrialoor group.*

Fig. ... 25. INFUNDIBULUM? p. 318; *Moraviatoor, Ootatoor group.*

Fig. ... 26. HELCION CARNATICUM, *Stol.*, p. 323; side-view of a fragmentary specimen, enlarged; *Comarapolliam, Arrialoor group.*

Fig. ... 27. TECTURA FOOTEANA, *Stol.*, p. 323; 27, natural size; 27 a and 27 b, side- and top-views, enlarged; *Comarapolliam, Arrialoor group.*

Fig. ... 28. PATELLA? sp., p. 329; internal view of a specimen; *E. of Odium, Ootatoor group.*

Fig. ... 29. SOLARIUM ARCOTENSE, *Stol.*, p. 255; front-, top- and basal-views enlarged twice the natural size; 29 c, more enlarged portion of the top-part of a whorl; 29 d, same of the basal part; *Ninnyoor, Arrialoor group.*

Fig. ... 30. SOLARIUM KURRIBIEMSE, *Stol.*, p. 256; similar figures as of the last species; *Kurribiem, Arrialoor group.*

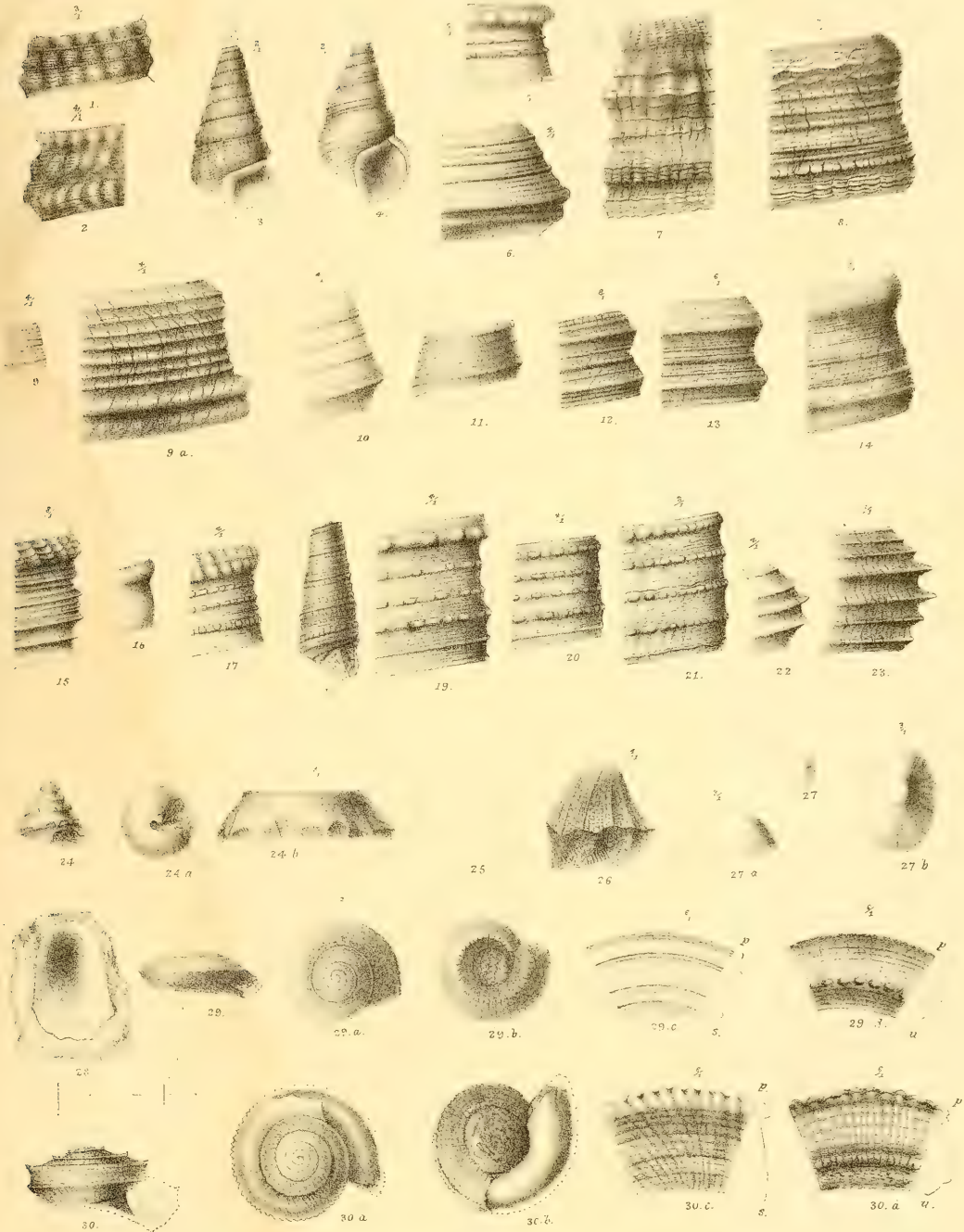

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PLATE XXI.

Fig. ... 1. CHEMNITZIA sp., p. 286; front-view of an imperfect specimen; *Shillagoody; Arrialoor group.*

Fig. ... 2. CHEMNITZIA sp., p. 287; front-view, the probable shape of the aperture restored in outline; *E. of Anapaudy; Trichinopoly group.*

Figs. 3—5. EUCHRYSALIS GIGANTEA, *Stol.*, p. 289; 3, front-view of a small, rather imperfect specimen; 4, front-and back-views of a large shell with well preserved surface, the aperture is restored in outline, but it ought to be a little narrower; 5, back-view of a smaller specimen exhibiting the striæ of growth; *Comarapolliam; Arrialoor group.*

Fig. ... 6. ODOSTOMIA ANTIQUA, *Stol.*, p. 182; front- and back-views of a specimen, enlarged to twice the natural dimensions; *Garudamungalum; Trichinopoly group.*

Figs. 7-8. EUSPIRA PAGODA, *Forb.*, p. 301; 7, a young, 8, a more fully grown, specimen, both nearly perfect; between *Andoor and Veraghoor; Arrialoor group.*

Fig. ... 9. EUSPIRA ROTUNDATA, *Sow.*, sp., p. 303; front- and back-views of a tolerably perfect specimen; *Comarapolliam; Arrialoor group.*

Fig. ... 10. AMAUROPSIS PANNUCEA, *Stol.*, p. 299; front-view of a large specimen with perfect aperture, but the spire broken of; *Karapaudy; Arrialoor group.*

Figs. 11—15. AMPULLINA BULBIFORMIS, *Sow.*, sp., p. 300; views of specimens of various sizes, 11, 12, 13, 15 are from the neighbourhood of *Garudamungalum; Trichinopoly group;* 14 is from *Comarapolliam; Arrialoor group.*

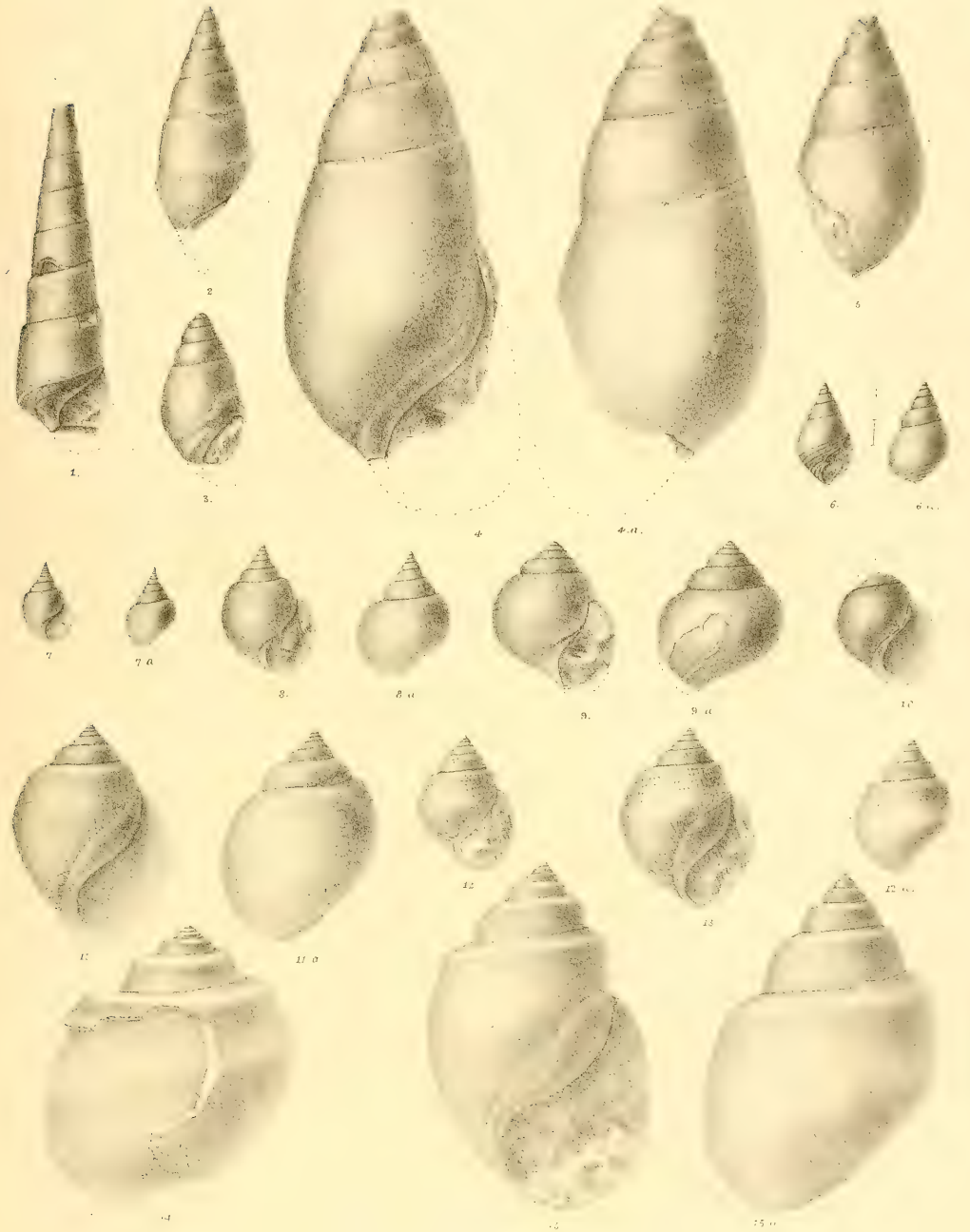
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PLATE XXII.

Fig. ... 1. AMAUROPSIS PANNUCEA, *Stol.*, p. 299; front- and back-views of a small specimen with the spiral striation distinct; *Karapaudy; Arrialoor group.*

Fig. ... 2. EUSPIRA LIRATA, *Sow.*, sp., p. 303; front-top- and back-views of a small specimen; *Ninnyoor; Arrialoor group.*

Figs. 3-4. EUSPIRA SPISSATA, *Stol.*, p. 303; 3, front- and back-views of a perfect and apparently nearly full grown specimen; 4, back-view of a smaller specimen with proportionately shorter spire and posteriorly more flattened whorls; *Kolakonuttom; Ootatoor group.*

Fig. ... 5. MAMMILLA CARNATICA, *Stol.*, p. 307; a perfect specimen enlarged to twice the natural dimensions; between *Andoor* and *Veraghoor; Arrialoor group.*

Figs. 6—8. EUSPIRA MARLÆ, *d'Orb.*, p. 304; 6, a young specimen; 7, somewhat larger, both with the edge of the outer lip not quite perfect; 8, view of a full grown and perfect specimen; 6 and 7 are from *Alundanapooram;* 8 is from *Kullygoody; Trichinopoly group.*

Figs. 9—13. GYRODES PANSUS, *Stol.*, p. 305; 9 and 10 young, but rather perfect specimens with the crenulations at the edge of the umbilicus very distinct; 11, top-view of a large specimen with the shell along the suture broadly flattened and the striæ of growth flexuous; 12, full grown, perfect specimen, different views; 13, back-view of large specimen with rather elevated spire; all from the neighbourhood of *Moraviatoor; Ootatoor group.*

Fig. ... 14. GYRODES TENELLUS, *Stol.*, p. 306; front- top- and back-views of a specimen injured at the outer lip; *E. of Anapaudy; Trichinopoly group.*

Fig. ... 15. EUSPIRA INDRANA, *Stol.*, p. 302; front- and back-views of a large specimen anteriorly and at the outer lip somewhat injured; *E. of Anapaudy; Trichinopoly group.*

Fig. ... 16. VANIKORO MUNITA, *Forbes*, sp., p. 309; front- top- and back-views of a large specimen; the ornamentation and partially the form have been corrected from a well preserved, small specimen; *N. of Odium; Ootatoor group.*

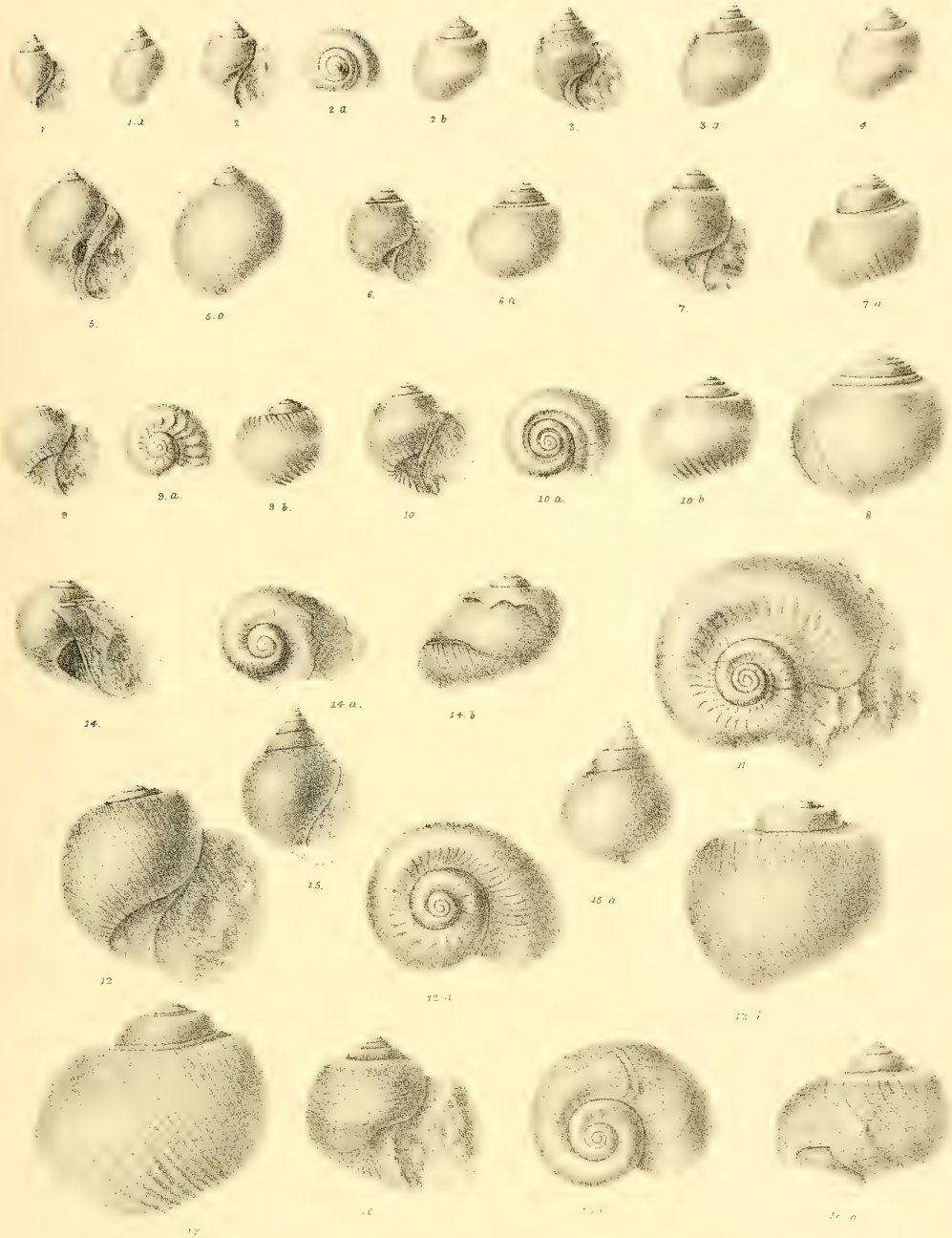
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PLATE XXIII.

Fig. ... 1. MAMMILLA EDURA, *Stol.*, p. 306; front- basis- and back-views of an apparently full grown specimen; *Ninnyoor; Arrialoor group.*

Figs. 2-3. AMPULLINA SORTITA, *Stol.*, p. 301; 2, back-view of a small specimen with rather elevated spire; 3, a large specimen, perfect on the inner lip, the form of outer lip restored in outline; *Ninnyoor; Arrialoor group.*

Fig. ... 4. VELUTINA ORIENTALIS, *Stol.;* p. 314; various views of a tolerably perfect specimen, enlarged; *Comarapolliam; Arrialoor group.*

Fig. ... 5. AMPLOSTOMA AURIFORME, *Stol.*, p. 315; front- and back-views of the unique specimen, aperture anteriorly imperfect; *Comarapolliam; Arrialoor group.*

Fig. ... 6. NATICINA ORNATA, *Stol.*, p. 314; specimen enlarged, the surface of the shell is only partially preserved; *S. E. of Arrialoor; Arrialoor group.*

Fig. ... 7. NERITOPSIS CRASSA, *Stol.*, p. 310; shell only partially preserved, perfect at the aperture; *Odium; Ootatoor group.*

Fig. ... 8. NERITINA COMPACTA, *Forbes,* sp., p. 339; front- and back-views of a small specimen; *Garudamungalum; Trichinopoly group.*

Figs. 9-10. NERITINA (VELATES) DECIPIENS, *Stol.*, p. 340; 9, back-view of a rather roundish oval specimen; 10, a more transversally elongated specimen; *Comarapolliam; Arrialoor group.*

Figs. 11-12. NERITA DIVARICATA, *d'Orb.*, p. 340; 11, a large specimen with a perfect inner lip, the shape of the outer one is restored in outline; 12, back-view of a smaller specimen, the ornamentation ought to be a little more distinct; *S. E. of Parchairy; Arrialoor group.*

Figs. 13-14. NERITA CAROLINA, *Stol.*, p. 341; 13, a young specimen with the dentition on the inner lip quite perfect; 14, a well preserved, large shell; *Seraganoor; Arrialoor group.*

Fig. ... 15. PHASIANELLA CONULA, *Stol.*, p. 355; a small specimen, anteriorly injured; *Comarapolliam; Arrialoor group.*

Fig. ... 16. PHASIANELLA GLOBOIDES, *Stol.*, p. 354; the outer lip is not perfectly preserved and the enamel surface of the shell removed; in perfect state the specimen would be probably quite smooth; *Olapaudy; Arrialoor group.*

Figs. 17—19. PHASIANELLA INCERTA, *Forbes,* 354; 17, a small, imperfect specimen from *Garudamungalum;* 18, large specimen imperfect on the outer lip, from *Alundanapooram; Trichinopoly group;* 19, a perfect, but distorted, large specimen from *Karapaudy; Arrialoor group.*

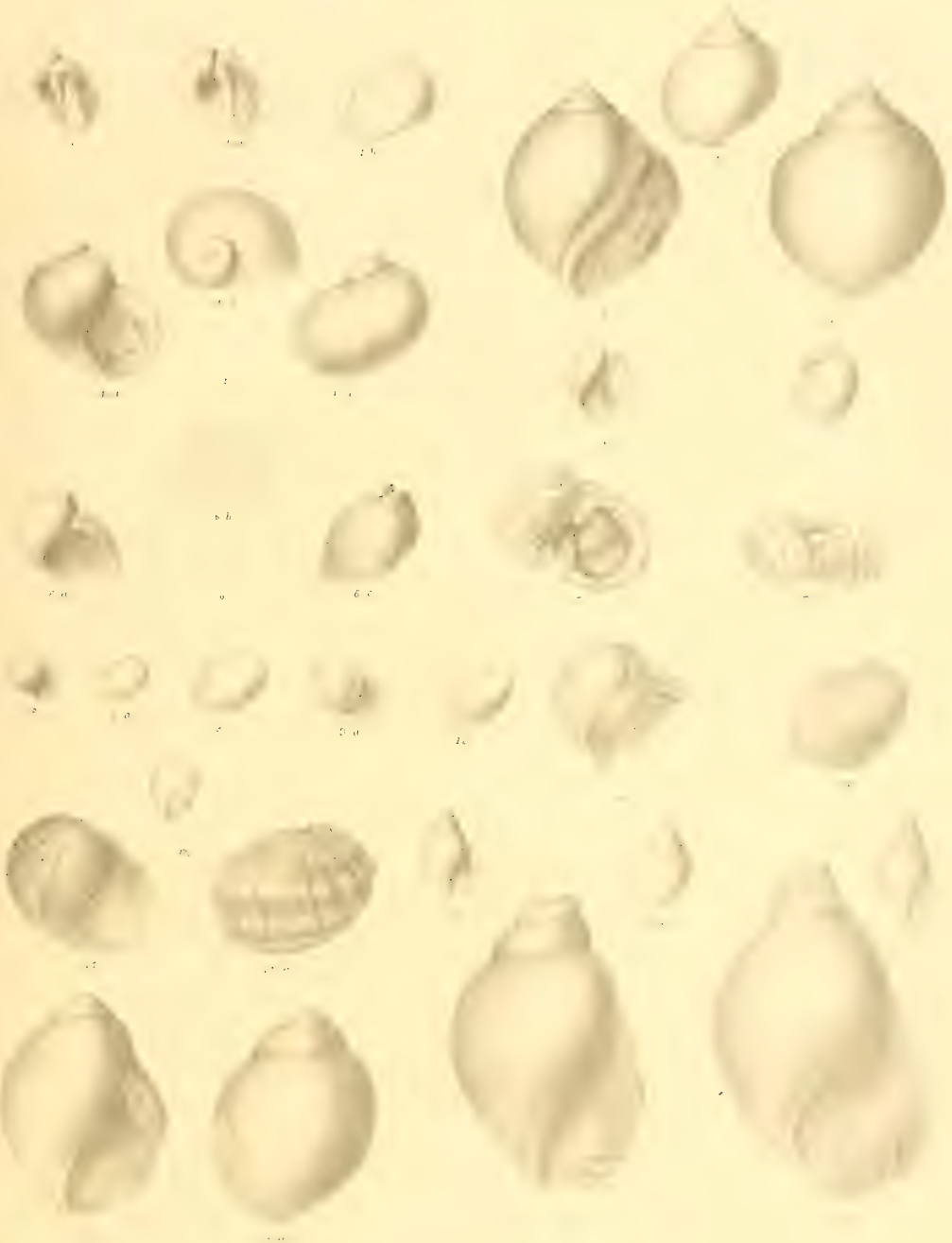

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PLATE XXIV.

Fig. ... 1. CANTHARIDUS STRIOLATUS, *Stol.*, p. 374; front- and back-views enlarged three times the natural size; *Comarapolliam; Arrialoor group.*

Fig. ... 2. OXYTELE NOTABILIS, *Stol.*, p. 369; front- and back-views, the form of the outer lip shown in outline; *Comarapolliam; Arrialoor group.*

Fig. ... 3. TECTUS JUNCEUS, *Stol.*, p. 372; imperfect, unique specimen; *Comarapolliam; Arrialoor group.*

Figs. 4-5. TECTUS TAMULICUS, *Stol.*, p. 371; 4, young specimen with distinct spiral striation on the upper whorls; 5, front- and basis-views of a full grown specimen; *Comarapolliam; Arrialoor group.*

Figs. 6-7. GIBBULA JERDONIANA, *Stol.*, p. 370; 6, back-view of a small specimen with strong, spiral striæ; 7, front- and basis-views of a perfect shell; *Comarapolliam; Arrialoor group.*

Figs. 8-9. GIBBULA GRANULOSA, *Stol.*, p. 370; 8, front- and back-views of a small-, 9, front- and basis-views of a somewhat larger specimen; 9 c, represents a portion of a whorl enlarged to six times the natural size; 8 is from *Vylapaudy*, 9 from *Comarapolliam; Arrialoor group.*

Fig. ... 10. EUCHELUS ORNATUS, *Stol.*, p. 371; front- basis- and back-views of a small specimen, enlarged to three times the natural size; *Comarapolliam; Arrialoor group.*

Figs. 11—15. ZIZIPHINUS (EUTROCHUS?) GEINITZIANUS, *Reuss*, sp., p. 373; 11, front-view, *Veraghoor;* 12, front- and basal-views; 13, top-view, both from near *Arrialoor;* 14, front-view, and portion of a whorl enlarged four times; *Veraghoor;* 15, same views; *Olapaudy;* all the figures representing entire specimens are double the natural size; *Arrialoor group.*

Fig. ... 16. MARGARITA ORBICULATA, *Stol.*, p. 377; front- and basal-views in thrice the natural size, the shell surface is only partially preserved; *Andoor; Trichinopoly group.*

Figs. 17—19. SOLARIELLA RADIATULA, *Forbes*, p. 375; 17, front-view of a fully grown specimen, natural size, the whorls are a little too high; *Olapaudy;* 18, front- and basis-views of a perfect specimen, fully grown, twice the natural size; *Comarapolliam;* 19, front- and back-views of a small, perfect specimen from the same locality; *Arrialoor group; (see* Plate XXVIII, Figs. 8-9).

Fig. ... 20. SOLARIELLA STRANGULATA, *Stol.*, p. 376; front- and basal-views of a well preserved specimen; *Odium; Ootatoor group; (see* Plate XXVIII, Fig. 10).

Fig. ... 21. LITHOPOMA INTERSECTA, *Stol.*, p. 360; front- and back-views of the unique specimen; *(see* also Plate XXVIII, Fig. 15); *Comarapolliam; Arrialoor group.*

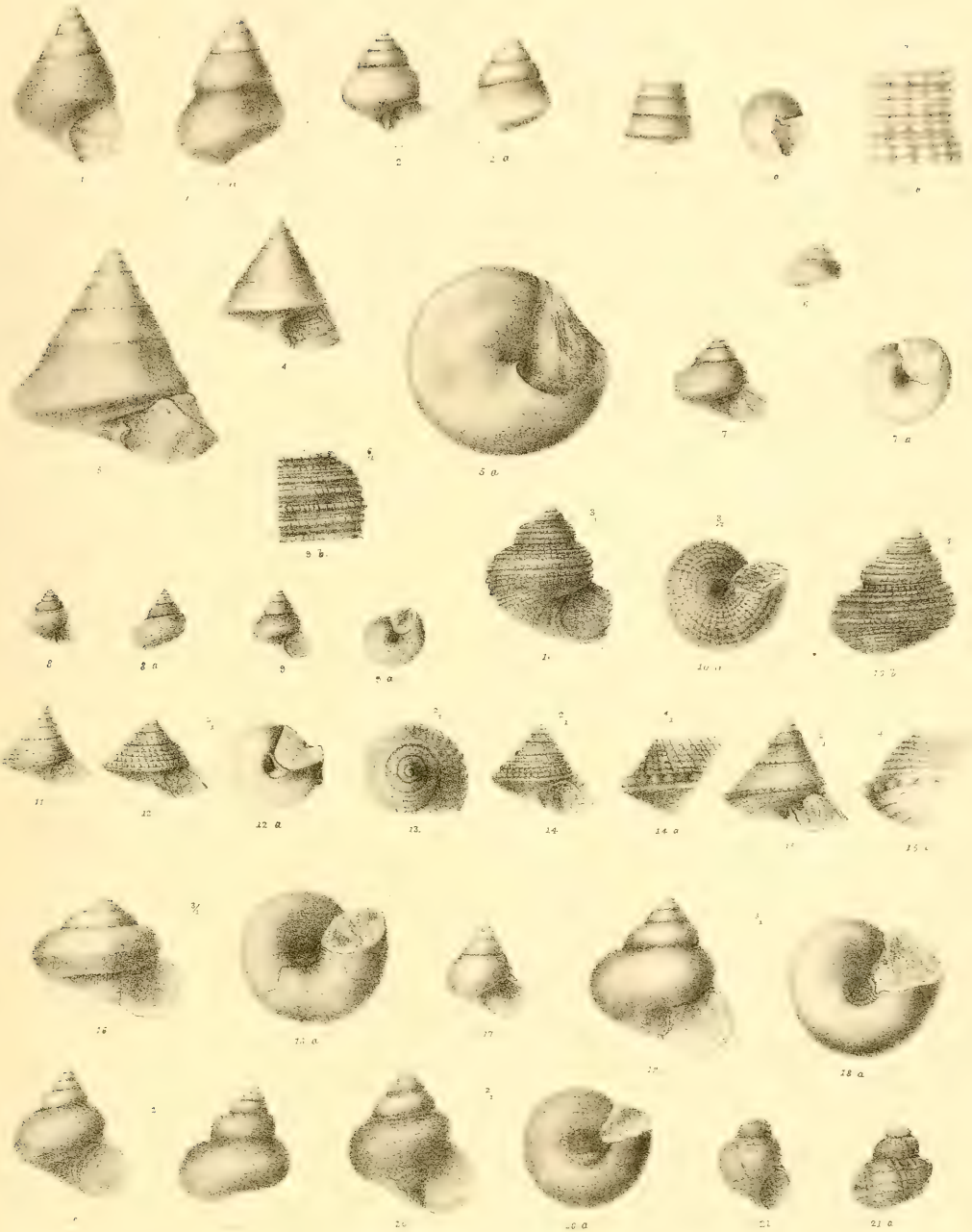

PLATE XXV.

Fig. ... 1. Rissoina acuminata, *Müller*, p. 280; front- and side-views in twice the natural size; *Comarapolliam; Arrialoor group.*

Fig. ... 2. Astralium carnaticum, *Stol.*, p. 358; front- and top-views of a somewhat imperfect specimen, but the best yet found preserved; *Moraviatoor; Ootatoor group.*

Fig. ... 3. Delphinula annularis, *Stol.*, p. 377; front- and top-views, the shell only partially preserved; *Odium; Ootatoor group.*

Fig. ... 4. Pleurotomaria loricatula, *Stol.*, p. 385; front- basal- and back-views, showing the length of the slit; in 4 c the peculiar ornamentation of the surface is shown in twice the natural measurements; *N. E. of Odium; Ootatoor group.*

Fig. ... 5. Calcar jugosus, *Stol.*, p. 359; basal- and front-views of a somewhat imperfect specimen, the shell surface not being well preserved; *Moraviatoor; Ootatoor group.*

Fig. ... 6. Nerita rugosissima, *Forbes*, p. 342; front- and back-views, the outer lip is restored in outline, enlarged to twice the natural size; *S. E. of Parchairy; Arrialoor group.*

Fig. ... 7. Teinostoma cretaceum, *d'Orb.*, p. 350; front- top- back- and basal-views of a small, well preserved shell; *Comarapolliam; Arrialoor group.*

Figs. 8-9. Pleurotomaria glabella, *Stol.*, p. 386; 8, front- and basal-views of a cast; 9, similar views of a larger specimen with the shell surface partially preserved; in 9 b, a small portion of one whorl is enlarged, showing the proportions of the width of the band to the height of the whorl and its ornamentation; *S. of Puravoy; Ootatoor group.*

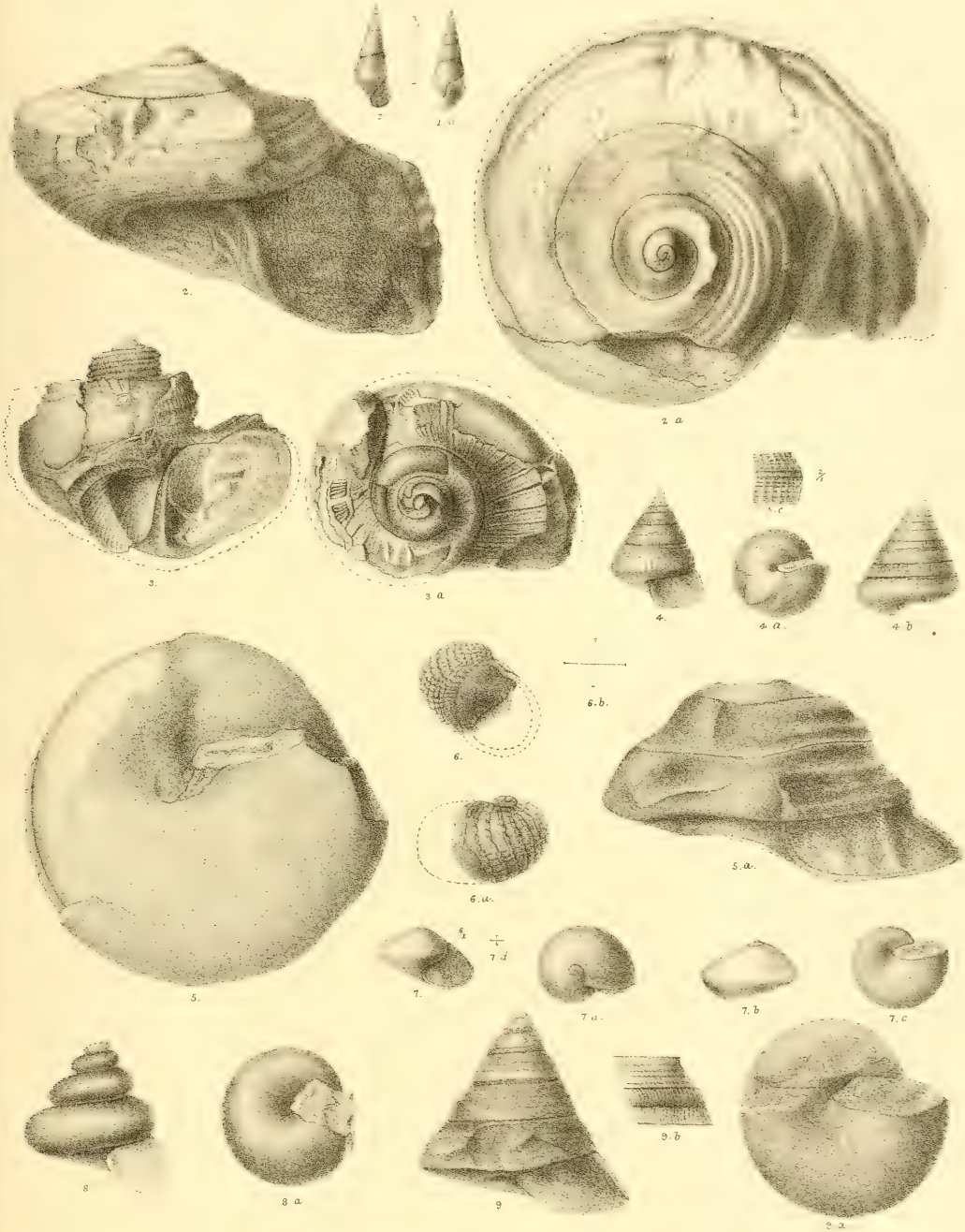

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PLATE XXVI.

Figs. 1—4. LEPTOMARIA INDICA, *Forbes*, p. 386; 1, front- and basal-views of a large, conical specimen with slightly convex whorls; *Comarapolliam;* 2, front- and top-views of a rather depressed specimen; 2 a, showing the usual irregularities in the spiral striation; 3, enlarged fragment of a whorl showing the well preserved surface of a small specimen; 4, front-view of a specimen with posteriorly, strongly flattened whorls; in all the enlarged figures 1 b, 3 and 4 a, the narrow band and the direction of the striæ of growth is noticeable; the three last specimens are from *Olapaudy;* and all are from the *Arrialoor group.*

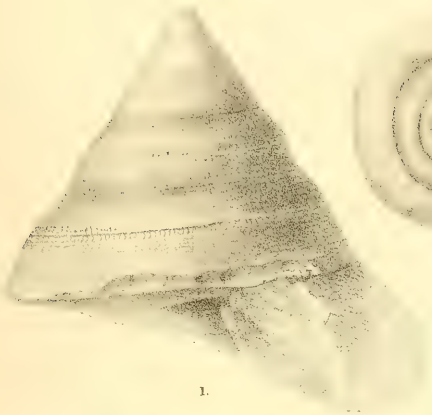
Fig. ... 5. EUPTYCHA GLOBATA, *Stol.*, p. 425; front- side- and back-views of a perfect shell, natural size; *Olapaudy; Trichinopoly group.*

Fig. ... 6. EUPTYCHA LARVATA, *Stol.*, p. 426; similar views as the last; the surface of the specimen is slightly worn off; *Comarapolliam; Arrialoor group.*

Fig. ... 7. EUPTYCHA OVIFORMIS, *Forbes*, p. 426; similar views as the former, a slightly imperfect specimen, the surface of the shell having been partially restored from another one; near *Serdamungalum; Trichinopoly group.*

Fig. ... 8. AVELLANA AMPLA, *Stol.*, p. 420; similar views as the former, a perfect specimen; *(see* Pl. XXVIII, Fig. 20); *Veraghoor; Arrialoor group.*

Fig. ... 9. AVELLANA SCROBICULATA, *Stol.*, p. 421; similar views as the former, a perfect specimen; *(see* Pl. XXVIII, Fig. 21); *Comarapolliam; Arrialoor group.*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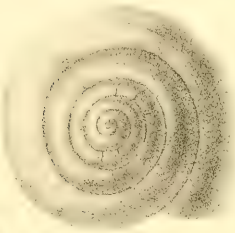
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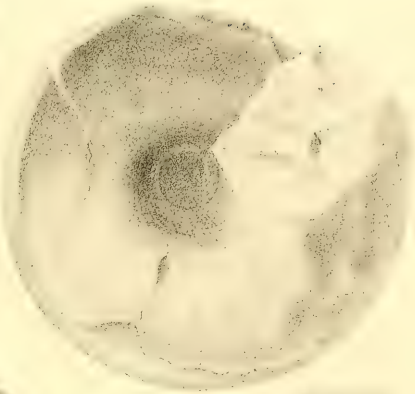
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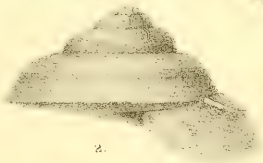
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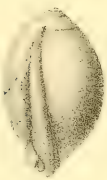
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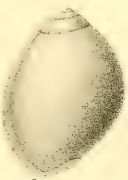
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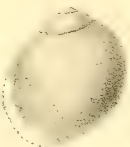
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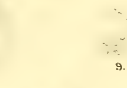
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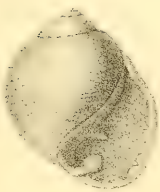
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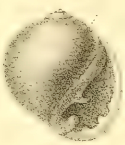
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PLATE XXVII.

Fig. ... 1. AVELLANA SCULPTILIS, *Stol.*, p. 422; front- side- and back-views of a perfect specimen *(see* Pl. XXVIII, Fig. 22); *N. E. of Karapaudy; Arrialoor group.*

Fig. ... 2. AVELLANA ELONGATA, *Guér.*, p. 422; similar views to the former, also a perfect specimen; *N. E. of Odium; Ootatoor group.*

Fig. ... 3. RINGICULA ACUTA, *Forbes*, p. 424; similar views of a perfect specimen; *Garudamungalum; Trichinopoly group.*

Fig. ... 4. RINGINELLA ACUMINATA, *Stol.*, p. 423; similar views; the outer lip and anterior portion of the shell are somewhat injured; *Comarapolliam; Arrialoor group.*

Figs. 5—7. ACTÆON (SOLIDULA) SEMEN, *Forbes*, p. 415; 5, a rather elongated specimen from *Garudamungalum;* 6 and 7, somewhat more inflated specimens from *Ninnyoor; Trichinopoly-* and *Arrialoor groups.*

Figs. 8-9. ACTÆON (SOLIDULA) PUGILIS, *Stol.*, p. 415; 8, an elongated, 9, a more inflated specimen with shorter spire; *Comarapolliam; Arrialoor group.*

Figs. 10-11. ACTÆON TURRICULATUS, *Stol.*, p. 416; 10, an elongated, 11, a more inflated specimen *(see* also Pl. XXVIII, Fig. 19); *Garudamungalum; Trichinopoly group.*

Figs. 12-13. ACTÆON CURCULIO, *Forbes*, p. 417; 12, a thinner, 13, a more inflated specimen, both partially restored from another specimen; *Comarapolliam; Arrialoor group.*

Fig. ... 14. BULLINULA OBTUSIUSCULA, *Stol.*, p. 420; front- and back-views of a somewhat imperfect specimen *(see* next Plate, Fig. 25); *Arrialoor; Arrialoor group.*

Fig. ... 15. ACTÆON JUNCEUS, *Stol.*, p. 417; front- and back-views of a specimen the ornamentation of which is partially restored from another one; *Odium; Ootatoor group.*

Fig. ... 16. ACTÆON SEMINATUS, *Stol.*, p. 416; front-view of a young specimen *(see* next Plate, Fig. 18); *Garudamungalum; Trichinopoly group.*

Figs. 17-18. BULLINA ALTERNATA, *Stol.*, p. 413; 17, front- top- and back-views of a well preserved specimen from *Garudamungalum;* 18, a smaller, somewhat more elongated specimen from *Veraghoor; Trichinopoly group.*

Fig. ... 19. BULLINA CRETACEA, *d'Orb.*, p. 414; front- back- and top-views of a well preserved shell; *Garudamungalum; Trichinopoly group.*

Fig. ... 20. CYLICHNA INERMIS, *Stol.*, p. 431; front- and top-views of a specimen, anteriorly somewhat imperfect; the surface of the shell is also slightly worn off; *Comarapolliam; Arrialoor group.*

Fig. ... 21. DENTALIUM CRASSULUM, *Stol.*, p. 444; side-view and section of the shell represented by three different fragments; *S. of Serdamungalum; Trichinopoly group.*

Fig. ... 22. FUSTIARIA PARVULA, *Stol.*, p. 445; a small well preserved shell with the posterior fissure distinct; *Pondicherry; Valudayur group.*

Fig. ... 23. ANTALE ARCOTINUM, *Forbes*, sp., p. 445; the posterior termination is very nearly perfect; *Pondicherry; Valudayur group.*

Figs. 24-25. ANTALE GLABRATUM, *Stol.*, p. 445; 24, dorsal side of a broken specimen, showing the longitudinal furrows; 28, side-view and sections of a larger specimen; the surface of the shell is in neither perfectly preserved; *Odium; Ootatoor group.*

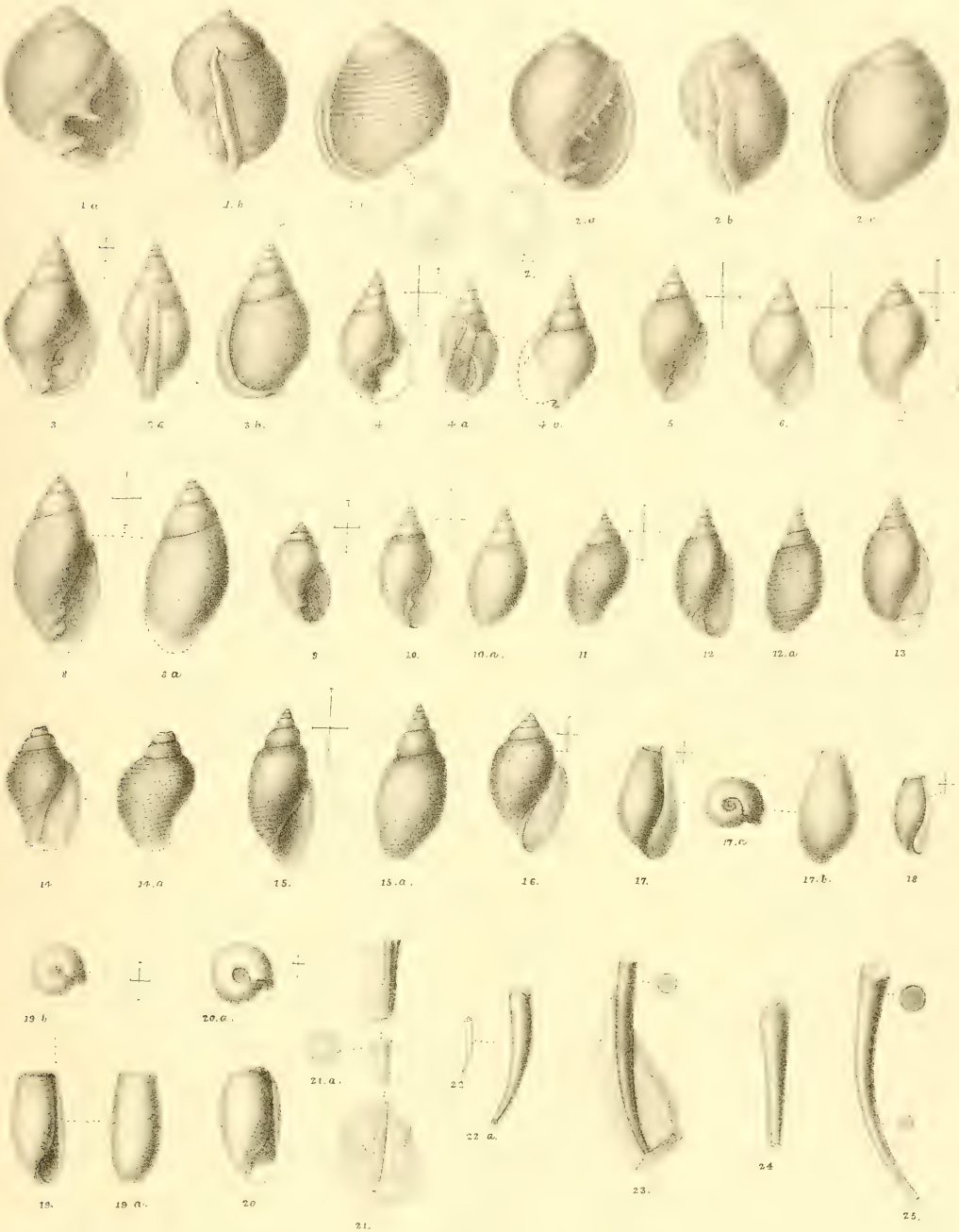
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Fig. ... 17. Trochactæon minutus, *Stol.*, p. 418; front-view of a small specimen; the outer lip restored in outline *(see* Pl. XIV, Fig. 9); *Comarapolliam; Arrialoor group.*

Fig. ... 18. Actæon seminatus, *Stol.*, p. 416; enlarged figure of a well preserved specimen from *Garudamungalum; Trichinopoly group.*

Fig. ... 19. Actæon turriculatus, *Stol.*, p. 416; portion of the antepenultimate whorl (of the specimen represented Pl. XXVII, Fig. 10) enlarged, to show the difference in the striation between this and the previous species.

Fig. ... 20. Avellana ampla, *Stol.*, p. 420; enlarged portion of the surface of the shell; *(see* Pl. XXVI, Fig. 8).

Fig. ... 21. Avellana scrobiculata, *Stol.*, p. 421; enlarged shell surface; *(see* Pl. XXVI, Fig. 9).

Fig. ... 22. Avellana sculptilis, *Stol.*, p. 422; enlarged shell surface; *(see* Pl. XXVII, Fig. 1).

Figs. 23-24. Avellana elongata, *Guér.*, p. 422; enlarged portions of the shell surface; *(see* Pl. XXVII, Fig. 2).

Fig. ... 25. Bullinula obtusiuscula, *Stol.*, p. 420; front- top- and back-views of a small specimen, with the aperture tolerably well preserved; *Pondicherry; Arrialoor group.*

Fig. ... 26. Actæonina columnaris, *Stol.*, p. 413; front- side- and back-views enlarged; the outer lip is posteriorly a little imperfect; *Pondicherry, Valudayur group.*

Fig. ... 27. Dipsacus vetustus, *Forbes*, sp., p. 452; similar views as the last; original specimen of Forbes' *Oliva vetusta* from the London Geol. Society's collection; *Pondicherry; Arrialoor group.*

Fig. ... 28. Ringicula labiosa, *Forbes*, sp., p. 424; front- and side-views of Forbes' original specimens of *Tornatella labiosa* and *Aptycha id.*, Meek; from London Geol. Society's collection; *Pondicherry; Arrialoor group.*

Fig. ... 29. Cypræa Cunliffei, *Forbes*, p. 450; front- and top-views, and portion of the shell surface of Forbes' original specimen in London Geol. Society's collection *(see* Pl. IV, Fig. 1); *Pondicherry; Arrialoor group.*

Fig. ... 30. Cypræa (Epona) globulina, *Stol.*, p. 451; front- and top-views; the shell surface is on the back and on the outer lip partially removed; *Pondicherry; Arrialoor group.*

Fig. ... 31. Actæonina obesa, *Stol.*, p. 412; front- and back-views of an imperfect specimen, the probable shape of the entire shell being restored in outline; *Comarapolliam; Arrialoor group.*

PLATE XXVIII.

Fig. ... 1. VERMICULUS ANGUIS, *Forbes*, p. 243; side-view of a fragment and a portion of the surface of the shell enlarged; the specimen is in the London Geol. Society's collection and is the original of Professor Forbes' publication; *Pondicherry; Valudayur (or Arrialoor) group.*

Fig. ... 2. EULIMA (LEIOSTRACA) ANTIQUA, *Forbes*, p. 289; front-view of the unique and original specimen also deposited in the London Geol. Society's collection; the outer lip is somewhat imperfect; *Pondicherry; Valudayur (or Arrialoor) group.*

Fig. ... 3. TYLOSTOMA NATICOIDES, *d'Orb.*, p. 292; front-view of a specimen from Uchaux in d'Orbigny's collection in the Jardin des Plantes, Paris, to illustrate the generic characters of the genus *Tylostoma.*

Fig. ... 4. NERITINA COMPACTA, *Forbes*, p. 339; front- and back-views of Professor Forbes' original specimen from the London Geol. Society's collection; *Pondicherry; Arrialoor group.*

Fig. ... 5. NERITA DIVARICATA, *d'Orb.*, p. 340; front-view of a large specimen with the shell partially broken for the purpose of illustrating the different layers in the structure of the shell *(see* pp. 334-335); a, represents the rock mass; b, the outer, unaltered layer of the shell; c, the inner, callose, layer, changed into an aggregate of crystals of calcite; *Parchairy; Arrialoor group.*

Fig. ... 6. TECTURA (?) ELEVATA, *Forbes*, sp., p. 322; side- and top-views of the unique and original specimen from the London Geol. Society's collection; *Pondicherry; Arrialoor group.*

Fig. ... 7. HELCION CORRUGATUM, *Forbes*, sp., p. 323; similar views as the last of the original specimen; also deposited in the London Geol. Society's collection; the shell surface is only partially preserved; *Pondicherry; Arrialoor group.*

Figs. 8-9. SOLARIELLA RADIATULA, *Forbes*, p. 375; two enlarged portions of the shell surface from near the suture; *(see* Pl. XXIV, Figs. 17-19).

Fig. ... 10. SOLARIELLA STRANGULATA, *Stol.*, p. 376; enlarged portion of the shell surface from near the suture; *(see* Pl. XXIV, Fig. 20).

Fig. ... 11. EMARGINULA (*conf.*, GUERANGERI, *d'Orb.*), p. 394; top- and side-views of a cast specimen, apex broken off; *Odium; Ootatoor group.*

Fig. ... 12. UVANILLA RAJAH, *Forbes*, sp., p. 360; front-view of the original specimen from the London Geol. Society's collection; *Pondicherry; Arrialoor group.*

Fig. ... 13. ? DELPHINULA ROTELLOIDES, *Forbes*, sp., p. 378; front-view of the original specimen from the London Geol. Society's collection; *Pondicherry? Arrialoor group.*

Fig. ... 14. GIBBULA GRANULOSA, *Stol.*, p. 370; enlarged figure of the same specimen as represented in Fig. 8 on Pl. XXIV.

Fig. ... 15. LITHOPOMA INTERSECTA, *Stol.*, p. 360; front-view of the same specimen as represented in Fig. 21, Pl. XXIV.

Fig. ... 16. VITRINELLA ORBICULATA, *Stol.*, p. 350; top- basal- and front-views of a well preserved small specimen; *Verdachellum; Verdachellum group.*

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